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PROTECTIVE TECHNOLOGICAL COATINGS FOR TITANIUM ALLOYS

Moscow MASHINOSTROITEL' in Russian No 10, Oct 81 pp 16-17

SOLNTSEV, S. S., doctor of technical sciences, ROZENENKOVA, V. A., candidate of technical sciences and IVASHCHENKOVA, N. N.

[Abstract] A study of the properties of coatings as a function of composition indicated the most promising ones to be EVT-26M, EVT-26M-2 for protection of titanium alloys at up to 650-850°C; EVT-24, EVT-24K and eVT-25 - for 800-1050°C; and EVT-100K or EVT-100M at 1050-1200°C. The protective effect of the coatings was estimated based on the status of the surface of the alloy, depth of gas-saturated area, microstructure and results of studies of mechanical properties of specimens after heating in air, purified argon and with the coatings. Microscopic x-ray spectral analysis of the surface of the specimens was performed to determine possible interaction of the titanium with the components of the coatings. It was found also that coatings types EVT-7, EVT-26M and EVT-26M-2 may spontaneously separate from the surface of the parts being protected due to stresses arising in the coatings as a result of differences in the coefficient of linear thermal expansion of coating and metal when their operating temperature range is exceeded. Details of the composition of the coatings mentioned are not presented, since they are series produced and technical documentation is available.
[46-6508]

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INFLUENCE OF PROTECTIVE TECHNOLOGICAL COATINGS ON DUCTILITY OF TITANIUM ALLOYS

Moscow MASHINOSTROITEL' in Russian No 10, Oct 81 pp 17-18

OSTASHEV, A. M.

[Abstract] Work has been performed on the use of the coatings EVT-26, EVT-26M, EVT-26M2 during hot sheet stamping and heat treatment of the titanium alloys T6S, OT4-1 and OT4-0. The coatings were applied either by a paint sprayer or by

dipping. The uniformity of the coatings is improved if layers are applied to blanks heated by 70-90°C. A study was made of the influence of the rate of heating (annealing) in combination with the use of technological protective coatings on the mechanical and technological properties of OT4-1 alloy. The studies confirmed the advantage of simultaneous use of high speed heating and protective coatings to increase the ductility of cold-shaped titanium alloys.
[46-6508]

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COATINGS OF CARBON FIBER WITH TITANIUM CARBIDE AND DIBORIDE

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 5, Sep-Oct 81
(manuscript received 27 Jul 79) pp 134-139

SHORSHOROV, M. Kh., SAVVATEYEVA, S. M., TSIRLIN, A. M., MOSIN, A. M., PRONIN, Yu. Ye., PLETYUSHKIN, A. A., IVANOVA, L. M., SULTANOVA, T. N. and SINITSYN, Ye. M., Moscow

[Abstract] Thin layers of titanium carbide and diboride were produced on the surface of carbon fibers by the method of chemical precipitation from the gas phase. The process was based on the reaction of reduction of volatile titanium and boron halides by hydrogen at a temperature of over 900°C. Preliminary calculations showed that the equilibrium concentrations of the reaction products in the system Ti-B-Cl-H are below $1 \cdot 10^{-4}$ moles except for titanium chloride, boron bromide, hydrogen, hydrochloric acid, titanium chloride and $BHCl_2$. The concentrations of gaseous Ti and B were also calculated to estimate the possibility of coprecipitation with titanium boride. The calculations were performed in the 1100 to 1800°K interval for a total pressure of 0.1 MPa and a B:Ti ratio of 1:3/2.2 and 3. Temperature and concentration conditions for production of compact TiC and TiB_2 coatings on carbon fibers with high adhesion strength and well-developed dispersion structure were optimized. Figures 4; references 12: 5 Russian, 7 Western.
[38-6508]

UDC: 621.762.001.4

DEFORMATION AND ORIENTATION OF FIBERS UPON EXTRUSION OF COMPOSITE MATERIALS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 10, Oct 81 (manuscript received 28 Feb 81) pp 41-44

PETROSYAN, A. S., PETROSYAN, G. G. and PETROSYAN, Kh. L., Yerevan Polytechnical Institute

[Abstract] Experiments were performed in stages: first stage, extrusion of model specimens reinforced with various fibers (copper, steel type 55, molybdenum) parallel to the axis of extrusion; second stage, extrusion of model specimens reinforced with steel fibers at various orientations. Diagrams of billets and extruded specimens and photographs of specimens containing fibers after extrusion are presented. It is found that a characteristic feature of the process of extrusion of a fiber composite material is very high ductility of the fibers, not observed in other types of deformation. Selecting the fiber material for its ductility and selecting the extrusion conditions, one can predict the properties of the anisotropic composite material with maximum hardening effect. The effect of superplasticity in the process of extrusion allows composite materials to be achieved with significantly lower ratios of ℓ/d of fibers, simplifying technological utilization while retaining excellent strength properties. Figures 3.
[45-6508]

FERROUS METALLURGY

TECHNICAL ADVANCES IN IRON AND STEEL INDUSTRY

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 5, May 81 pp 26-33

[Article by V. Zelinskiy, deputy department chief, USSR Gosplan: "Scientific and Technological Advance -- Foundation of Development of Ferrous Metallurgy"]

[Text] The Soviet Union possesses a powerful economy and vast scientific and technological potential at the stage of mature socialism. Ferrous metallurgy plays a most important role in creation of our country's economic might.

Scientific and technological advances, growth and development of all branches of industry and agriculture are directly linked with production and utilization of various structural materials, particularly ferrous metals. The percentage share of the latter in machine building, construction, transportation, and in other sectors of the Soviet economy is approximately 92 percent.

Ferrous metals have no equal in the majority of areas of application as regards their properties, and particularly strength, economy of manufacture, and utilization in the nation's economy.

There is gradually taking place at the present time, however, replacement of steel by other structural materials -- plastics, aluminum, glass, reinforced concrete, etc -- as their quality improves and cost of manufacture declines. But these new materials merely supplement ferrous metals.

An analysis of the development of industry, capital construction and transportation indicates that, in spite of a constant decrease in the percentage consumption of metals and the growing employment of new structural materials, a trend toward increase in ferrous metals consumption will continue in the foreseeable future.

The Soviet Union is the world's leading metallurgical power. The Soviet iron and steel industry is the world leader in production volume of pig iron, steel, finished rolled products, steel pipe, coke, ferroalloys, iron, manganese, and chromite ores.

Growth and development of the Soviet iron and steel industry are characterized by a rise in its technological level, high concentration of production, increase in the unit output capacity of metallurgical equipment, improvement of structure and quality, and expansion of the variety assortment of metal products. All this makes it possible to increase the efficiency of utilization of ferrous metals in the nation's economy.

Large, sophisticated 520 square meter roasting units, batteries of coke ovens with an output capacity of 1 million tons of coke per year, blast furnaces with a net volume of 3200 and 5000 m^3, oxygen converter shops with 300-350 ton capacity converters, high-output pipe and rolling mills, and shops to produce cold-rolled steel and curved structural shapes, meeting today's demands of technological advance, have been brought on-line at ferrous metallurgical enterprises.

Production of economical and advanced types of rolled stock and finished products, steel pipe and general metal products is growing at a priority pace. In the last three five-year plans, for example, with an overall 76 percent production growth for finished rolled products, cold-rolled sheet output increased by 130 percent, stainless steel sheet by 140 percent, low-alloy rolled steel by 270 percent, rolled stock with hardening heat treatment by 280 percent, curved structural shapes by 690 percent, etc.

Manufacture of rolled stock with more rigid dimensional tolerances has been increased to 42 million tons per year. There has been a substantial expansion of production and improvement in the quality of specialty rolled products and steel pipe.

During the years of the 10th Five-Year Plan, priority production growth in short-supply and economical metal products brought an annual savings of more than 3 million tons of rolled metal product to the nation's economy.

A number of large-scale organizational and technical measures have been carried out, aimed at intensive utilization of existing production facilities in all metallurgical processes and related subbranches.

Alongside successes, there have been serious deficiencies in ferrous metallurgy. In recent years there has been a substantial slowing of the rate of capital construction and delay in bringing many especially important shops and sections on-line. As a rule, duration of construction substantially exceeds standard figures. This as well as internal factors, in particular caused by a decline in the level of branch management, are leading to regular failure to meet production targets for principal types of metal product.

Measures pertaining to adoption of new equipment, advanced processes and retooling are being carried out slowly at the enterprises of this branch. Some economic performance indices of subbranches and principal ferrous metallurgical processes are worsening.

Reserve potential connected with adoption of scientific and technological advances is not being fully utilized. In rolled steel production, for example, output volume of heat-treated metal is insufficient, which diminishes the efficiency of employment of carbon and especially low-alloy steels, worsens their strength properties, leads to outright overconsumption of metal in the nation's economy, and reduces the service life of machinery and mechanisms by 15-30 percent.

Delays are occurring in bringing into operation electric furnaces with high-output transformers, with water-cooled walls and crown. Electric furnaces of this design have twice the output of existing units. Construction is proceeding slowly on the Soviet Union's first oxygen-converter shop with bottom blast at the Metallurgical Plant imeni F. E. Dzerzhinskiy.

More extensive employment of vacuum treatment of metal, treating metal with neutral gases and alloying in the ladle would make it possible to perform the processes of killing, refining and alloying outside the steelmaking unit, utilizing the latter only for melting the metal, which would have an appreciable effect on increasing labor productivity. The steelmaking unit ensures production of metal of improved quality and economical consumption of costly ferroalloys and alloying materials.

Poor quality of preparation of scrap for melting has a negative effect on the output of steelmaking units and reduces usable product yield.

In steelmaking the level of employment of continuous casting (11 percent) is insufficient, although the advantages of this process are obvious. At the Novolipetskiy Metallurgical Plant all steel is cast on continuous casting machines. The metal consumption factor in production of rolled steel at that plant is almost 200 kg/t less than the branch average.

At the Tulachermet NPO [Scientific-Production Association] construction is proceeding very unsatisfactorily on a unit for producing, heating and feeding to the blast furnace hot reducing gases (our country is the pioneer in development of this process).

The coking by-product industry has not yet adopted the process of thermal preparation of coal prior to coking, a process which makes it possible, when coal is preheated to 200°C, to boost the output of batteries of coke ovens currently in operation by 30-40 percent, with a simultaneous improvement in the mechanical strength of the coke.

Cyclic-flow technology is being adopted quite slowly in the mining industry, a technology which makes it possible substantially to boost labor productivity in ore production. Delays are occurring in development of an oxidized ferruginous quartzite beneficiation process.

The metallurgical industry is lagging badly in the area of preparing raw material for melting and in improving the structure of steel production and metal product assortment.

This predetermines to a great degree the predominance of metal cutting in machine building and metalworking and the employment of cast steel and iron structures. For a long time now the rolled metal utilization factor has not improved. The structure of consumption of ferrous metals in the construction industry and other industries is heavily focused on an obsolete product mix. Hence the inefficient utilization of ferrous metals and delay in the rate of growth and development of the entire national economy.

The Principal Directions of Economic and Social Development of the USSR for 1981-1985 and the Period up to 1990 revealed the prospects and defined the main tasks of the iron and steel industry.

Special attention is devoted to adoption of scientific and technological advances, which are the principal means of guaranteeing dynamic growth and development in ferrous metals production, increasing production intensiveness, and achieving radical improvement in the quality of metal products with the least expenditure of capital, material and labor resources.

Specified for all metallurgical production processes and subbranches is the adoption of new and substantial improvement of existing advanced manufacturing processes and techniques, as well as other technological progress measures.

In order to increase the output of blast furnaces and reduce the economy's pig iron requirements, plans call for reducing production of foundry pig iron and ferroalloys in blast furnaces, organizing commercial-scale production of steel in electric furnaces directly from metallized iron-ore pellets, accelerating the rate of production growth of synthetic pig iron in induction furnaces for casting, steel production in electric furnaces, and carrying out a number of other measures.

In blast furnace production plans call for further blast oxygen enrichment, increased iron content and percentage share of prepared raw iron ore in the blast furnace charge, boosting blast temperature, and utilization of other advanced blast furnace smelting techniques.

Plans call for the extensive employment of pig iron production with oxygen blast enrichment to 35 percent. This will make it possible to increase utilization of natural gas, to reduce coke consumption, and to increase blast furnace production intensity to a level never before achieved in world steelmaking practices.

Plans call for adoption of a fundamentally new blast furnace process involving injection of hot reducing gas. Calculations indicate that employment of this process can boost blast furnace output by 25-30 percent and result in up to 30 percent savings in short-supply coke.

In 1985 more than 67 percent of the total pig iron production growth will be accounted for by blast furnaces brought on-line before 1 January 1981.

Considerable attention has been devoted to retooling blast furnace production. In the 11th Five-Year Plan a new blast furnace with a net volume of 5,580 m^3 and an output capacity of 4.5 million tons is scheduled for construction and production start-up at the Cherepovets Metallurgical Plant. Plans call for renovating four existing blast furnaces, increasing their output to 1.4 million tons. Thirteen low-output, obsolete blast furnaces representing a total production capacity of 1.7 million tons are to be retired.

All steel production growth in 11th Five-Year Plan will be obtained through priority growth of electric furnace steel and oxygen-converter steel production, which in 1985 will be 60 percent and 30 percent greater than 1980 production figures respectively.

increase in converter steel production will be accomplished both by modernizing and improving existing shops and by bringing on-line new 350-400 ton converters. It is planned to increase the specific intensity of oxygen blast to 5-6 m^3/million tons and to increase the durability of the refractory lining to 1,000 melts, by improving the quality of refractories and employing guniting.

In electric steel production plans call for building new 100-200 ton furnaces.

In 1981-1985 plans call for retiring from service worn-out and obsolete steelmaking equipment representing a total production capacity of 3.2 million tons.

In order to improve steel quality and increase yield of usable metal, plans call for increasing the volume of out-of-furnace vacuum treating steel by 220 percent, treating with inert gases by 40 percent, with synthetic slags by 30 percent, pouring steel into ingot molds with employment of heat-insulating inserts -- by 60 percent, plus other measures.

There will be increased electric steel production with employment of metallized pellets, with continuous charging, as well as increased production of electrical engineering steel in converters, and argon-oxygen refining of stainless steel.

Continuous steel casting on continuous casting machines will double, reaching 35-37 million tons by 1985. An advantage of continuous casting lies in the fact that casting yield increases by 15-20 percent, depending on the grade of the steel, in comparison with casting into ingot molds. This means that when the targeted volume of utilization is reached, metal resources will increase by 2.5-3 million tons.

Targeted measures to improve steel production processes will make it possible to reduce steel consumption in 1985 for USSR Minchermet [Ministry of Ferrous Metallurgy] to 1,260 kg per ton of rolled stock, as compared with 1,275 kg in 1980.

There will be further substantial development of specialty steel metallurgical processes. In 1985 metal production by the electroslag vacuum-arc remelting method will increase by 70 percent over 1980, while production by the vacuum-induction melting method will triple.

Powder metallurgy will be developing at an accelerated pace, in order to obtain products with elevated resistance to wear, durability, corrosion resistance and other special properties. Metal powder output is targeted to increase by 230 percent by 1985.

Plans call for retooling Vtorchermet enterprises, increasing the volume of processing of metal scrap, and improving utilization of iron and steel scrap in waste in the nation's economy. In order to ensure high-quality metal charge for the electrometallurgical industry, plans call for increasing scrap metal processing volume from 27 million tons in 1980 to 35 million tons in 1985, or by 30 percent.

There will be an increase in production of complex ferroalloys and master alloys. Silicochrome production is targeted for a 30 percent increase above the 1980 level, with a 25 percent increase for silicocalcium. A shop for combined reducing agents and modifiers for producing pig iron with spheroidal graphite will be built at the

Stakhanovskiy Ferroalloys Plant, which will result in pig iron savings of more than 1 million tons.

In 1981-1985 the general direction taken by growth and development of the iron and steel industry will be satisfaction of the needs of the economy in ferrous metals, particularly by improving their quality, broadening the product mix, and priority manufacture of efficient and economical metal products.

Finished rolled products output is targeted to increase to 117-120 million tons in 1985, 13.5-16.5 percent greater than the 1980 figure. Plans call for increasing cold-rolled sheet production by 80 percent, rolled stock with hardening heat treatment by 120 percent, rolled products of low-alloy steel by 70 percent, coated sheet and thin sheet by 80 percent, cold-rolled steel strip by 60 percent, hot-rolled sheet steel 1-2 mm in thickness by 50 percent, and sections for consumption within the branch -- by 460 percent.

Hot-rolled sized merchant steel production is to be organized on a broad scale, involving almost total renovation. Production is to reach 1 million tons by 1985.

Calculations indicate that with the targeted high rate of production growth for economical and advanced types of metal products, metal savings obtained by the nation's economy in 1985, converted to rolled stock, will total 7 million tons, figured in distributing resources for rolled metal production, plus an additional 1 million tons by extending product service life, connected with improving strength and other metal properties.

Steel pipe and tube production is to reach a volume of 21 million tons by 1985, or 15.3 percent greater than the 1980 figure. A high production growth rate is targeted for many economical and short-supply pipe and tube products. For example, production of threaded pipe for the oil industry will increase by 150 percent in 1985, high-strength pipe -- by 160 percent, pipe for high-pressure boilers -- by 67 percent, and rolled bearing tubing -- by 53 percent.

In conditions of the contemporary scientific and technological revolution, the nature of the problems of development of this branch is changing. They are becoming increasingly more complex, comprehensive, intersectorial, and long-range problems are appearing.

All this demands improvement in planning and management. In recent years good results have been obtained by employing the method of specific-purpose or integral-process planning of scientific and technological advance -- from research and design to practical engineering, commercial incorporation, and retirement of obsolete products.

Experience shows that this method strengthens the existing system of planning and management, adapts it to solving major, first-priority problems, and focuses on end economic results. Specific-purpose comprehensive programs provide for backing up targets with material and financial resources, coordinating all tasks with production and capital construction plans, specifying work performance timetables, principal executing organizations, as well as entities directing the stages of development and adoption of the entire program.

GKNT [State Committee for Science and Technology], USSR Gosplan and the USSR Academy of Sciences have ratified a number of specific-purpose comprehensive scientific-technical programs pertaining to solving major problems of development of the iron and steel industry in the 11th Five-Year Plan and in the period up to 1990.

The comprehensive program for improving quality and expanding product mix calls for putting into production in 1981-1985 at enterprises of USSR Minchermet 500 hot-rolled, cold-shaped and other economical rolled structural shapes. A number of new products are targeted for manufacture in order to satisfy special customer requirements.

A most important direction for improving the quality of mass-application carbon steels will be improved homogeneity and fewer impurities in the metal, improved degree of surface finish and dimensional accuracy.

Rolled products should be supplied in conformity with the requirements of customer process automation, which will reduce metal consumption and improve production efficiency in the metal-consuming industry. By 1985 average metal strength will be 5-6 percent greater than in 1980.

The targeted high production volumes of cold-rolled sheet, electrical engineering steels, and cold-rolled strip will make it possible substantially to reduce imports of these metal products.

Taking account of the targeted movement on-stream of sheet mills essential for carrying out the program of improving quality and broadening product mix, as well as possible production growth on existing equipment, the percentage share of rolled sheet in total finished rolled products output for USSR Minchermet in 1985 will be 42 percent.

In the 11th Five-Year Plan there will be a substantial decrease in the metal requirements of steel pipe in the nation's economy. Programs specify the following: improvement in methods of calculating pipelines, revision of standards documents regulating employment of pipe in construction; preparation of technical documentation on utilization of steel pipe based on new standards, as well as new consumption standards, including standards pertaining to employment of steel pipe of reduced metal content in water supply, sewage disposal and heat distribution systems.

Recommendations are to be prepared on a reasonable product mix of steel pipe utilized in construction, as well as in other areas of pipe utilization, taking into account a 15-20 percent decrease in pipe specific consumption standards. Calculations indicate that the annual volume of pipe consumption will be reduced by 1 million tons as a result of this.

In addition to priority production growth for efficient and short-supply types of steel pipe, the following are targeted to go into production in the 11th Five-Year Plan: pipe of continuous-cast cored steel and continuous-section blank; oil industry threaded pipe of all strength categories, with new types of threaded connections and with anticorrosion coating.

The strength of oil and gas trunk pipeline pipe is to be increased to 75-100 kg/mm^2 as compared with 55-70 kg/mm^2 in 1980.

In conformity with the general direction of development of this branch of industry, capital investment should be directed primarily toward implementation of measures to improve structure and quality and expand the variety of metal products, with improved efficiency of metal products utilization in the nation's economy.

Capital spending on growth and development of fourth conversion process shops and construction of facilities to improve the quality of metal products is to be increased from 1.6 billion rubles in the 10th Five-Year Plan to 7 billion rubles in the 11th, or by 340 percent; there is to be an 80 percent increase in capital spending to boost production, expand product mix and improve quality of pipe, and a 50 percent increase on boosting ferroalloys production.

Production of merchantable iron ore is to be increased to 274 million tons in 1985.

Preparation of ore for smelting is one of the basic factors of technological advance in the mining industry. With this in mind, there will be a substantial increase in the quantity of ore subjected to concentration. In 1980 the percentage share of ore subjected to concentration was 85 percent, while in 1985 it will be 90 percent, and the percentage share of concentrate in total merchantable ore output -- 73 and 81 percent respectively. Production of concentrate with an iron content in excess of 65 percent will reach 110 million tons in 1985. In order to increase the percentage share of prepared iron ore in the blast furnace charge and in order to meet other needs of the nation's economy, plans call for priority growth in production of pelletized iron ore. Production of this raw material will increase to 72.7 million tons in 1985, or a 42 percent increase in 1980.

The percentage share of prepared iron ore in the blast furnace charge will increase to 98.6 percent in 1985 as compared with 96.1 percent in 1980. Only the high-grade ores of the Zaporozh'ye Iron Ore Combine and the naturally alloyed ores at the Orsk-Khalilovo Metallurgical Combine will be smelted in blast furnaces in an unbeneficiated condition.

All this will make it possible to create conditions for additional production of approximately 2 million tons of pig iron per year and to save 750,000 tons of coke, which is equivalent to building a large battery of coke ovens and a 3200 cubic meter blast furnace.

Of great importance for further development of the raw materials base of ferrous metallurgy is commercial exploitation of weak-magnetic oxidized ferruginous quartzites. Enormous reserves of these ores occur in favorable mining-geologic conditions and are not being utilized at the present time. A significant percentage is mined together with magnetite quartzites. The annual volume of by-product mining of these ores amounts to 50-70 million tons, or approximately 15 percent of total raw iron ore production. In the 11th Five-Year Plan facilities are to be built in Krivoy Rog and a process brought on-line for beneficiation and caking of oxidized ferruginous quartzites.

The largest facilities for producing iron-ore concentrates are to be brought on-line at the Kostomukshskiy, Stoylenskiy, Lebedinskiy, and Mikhaylovskiy mining and concentration combines. Targeted for production in the 11th Five-Year Plan at the Mikhaylovskiy GOK [Mining and Concentration Combine] are approximately 4 million tons of iron ore concentrate obtained by concentration of magnetic separation tailings.

Bulk coke production, 6 percent moisture content, will increase considerably in 1985. This increase will be balanced with the requirements of the nation's economy by carrying out a number of progressive measures to achieve savings in coke.

In blast furnace production it is planned to reduce the standard consumption figure on dry metallurgical coke for producing pig iron from 568 kg/t in 1980 to 535 kg/t in 1985, by increasing iron content in the iron-ore portion of the charge, by improving the blast furnace process, and by shortening the foundry pig iron and ferroalloys smelting times in blast furnaces. Performance of these as well as other measures will generate savings of about 5 million tons of coke in 1985 in the iron and steel industry alone. In addition, plans call for a number of measures to achieve a substantial reduction in coke consumption in other branches of the economy as well, particularly by increasing production of foundry pig iron in electric furnaces and utilization of special coke for producing yellow phosphorus and ferroalloys, coke obtained in annular furnaces from abundant-supply coals as well as graded lean coal for firing lime and dolomite. With the aggregate of these measures carried out in other branches, coke savings in 1985 will exceed 2 million tons.

An effective direction to take in expanding the raw materials base of coking and achieving savings in costly coking coals is preparatory heating of the coal charge for coking, which increases the output of coke-oven batteries from 30 to 40 percent and results in obtaining firm coke from poorly caking coals.

The first full-size commercial installation for thermal preparation of the coal charge for coking is slated to go into operation at the Western Siberian Metallurgical Plant in 1983. Successful start-up and operation of this unit will make it possible to obtain in 1985 4 million tons of coke with employment of a thermally prepared charge.

To expand the raw materials base of coking, plans call for producing molded metallurgical coke based on poorly-caking and noncaking coals.

New facilities for producing coke, including molded coke, are to be built and put into production in 1981-1985.

Specific features of scientific and technological advance in the iron and steel industry include profound qualitative changes in production technology, substantial design changes in metallurgical facilities and equipment, and radical improvement of interaction of the socioeconomic factors of production. It is precisely comprehensive resolution of these problems which will make it possible maximally to utilize the already established economic potential of the iron and steel industry and to plan execution of materials-economizing measures.

A basic feature of the 1981-1985 five-year plan is decrease in materials requirements at all stages of metallurgical production, which ensures an increase in end product output growth with a lower rate of production growth for raw materials and intermediate products. For example, production of finished rolled stock will increase by 16 percent in the period 1981-1985, steel production by 13.5 percent, and pig iron 9 percent.

Successful accomplishment of such complex tasks requires certain reorganization of operations of the USSR Ministry of Ferrous Metallurgy, branch design and scientific research institutes as regards shortening the time required to prepare technical documentation, strengthening of ties and continuous productive contacts with the principal production administrations and subdivisions of ferrous metallurgical enterprises and their corresponding planning-economic and engineer-technical services.

All available funds, resources and efforts of the engineer-technical services of this branch should be continuously concentrated on accelerated incorporation of scientific and technological advances, advanced know-how, improvement of production planning and management, and increasing the operating efficiency of each enterprise, shop, section, and unit.

Comprehensive assistance from related ministries -- construction and machine building -- is needed; these ministries determine the pace and success of retooling of ferrous metallurgical enterprises. It is a matter first and foremost of strengthening construction organizations at the principal iron and steel industry construction projects. It is necessary to solve the problem of economic incentive for construction organizations to accomplish retooling and renovation of shops and enterprises in the amounts and within the schedules specified by the five-year plan.

The machine building ministries must organize production of metallurgical equipment which is in conformity with modern demands as regards output and quality, must put into production multiple-roll cold rolling mills, coating units, extremely high-powered transformers for electric furnaces, electrodes, high-strength transformer strip, synthetic materials for coating metal products, etc.

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PROBLEMS AT KRIVOROZHSTAL' PLANT

Kiev PRAVDA UKRAINY in Russian 14 Nov 81 p 2

[Article by PRAVDA UKRAINY special correspondents G. Dubovoy and A. Pankratov, Dnepropetrovskaya Oblast: "An Order for Metal" (Conclusion. First part published in PRAVDA UKRAINY, 12 Nov 81)]

[Text] 2. Things Looked Good on Paper....

There is no need to say how important it is, in the conditions in which this republic's giant of the iron and steel industry finds itself, to engage extensively in socialist competition in order to put additional reserve potential into operation. According to official figures, 22 forms of collective and individual labor competition are operating at Krivorozhstal'. Competition encompasses 36,000 persons, 47 shops and 820 brigades. Labor competition is well organized in Blooming Mill Shop No 3, structural and merchant mill shops No 1 and 3, plus several others.

We can state without exaggeration, however, that on the whole competition at this plant is of a formalistic nature. This explains to a considerable extent the fact that in recent years the pledges of plant workers have remained merely on paper. For example, what kind of sense does it make to total up competition results if this is not done until the middle of the following month at the very earliest? After a couple of weeks people simply lose interest in past events and are concerned with other matters. For this reason the auditorium at the metallurgical worker's Palace of Culture is half empty as a rule when they are totaling up plant competition results....

Indifference is engendered first of all by a lack of responsibility in the campaign for achieving the specified performance figures and by the established practice of adjusting plan targets in the shops on the last day of the month. Frequently "equalizing" indices is done with the excuse that the work force failed to meet the target allegedly not through its own fault. As a result, lagging brigades rise to the level of average production forces, while leading brigades are deindividualized, as it were.

It frequently happens in Blast Furnace Shop 1 and Converter Shop No 2 that even after an equipment breakdown occurs, the work force receives a mark of excellent from the brigade council. Frequently the same kind of thing is encountered in the open-hearth shop and in Blooming Mill Shop No 2. When open-hearth shop superintendent

V. N. Gurov is asked whether he thinks that this does not diminish the role of competition, he replies: "If we have the plan, we will have everything else as well."

What a "philosophy".... It becomes understandable why for a period of many years metallurgical worker initiatives are born in this lagging work force and then proceed to die on the vine, one after the other. The comment has been made that if it is a short-term initiative -- for example, setting a unit 24-hour output record in honor of some important event -- it has a chance of success.

At the end of 1979 Komsomol members in the open-hearth shop suggested forming Komsomol-youth crane operator crews. This was particularly important for improving the performance of the pouring side -- the greatest "bottleneck." The young open-hearth shop workers set about to ensure not only normal equipment operations but also to accomplish prompt preventive maintenance. This initiative failed to develop adequate scope, as did others -- for excellent production practices, for excellent-quality steel.... The reason is a simple one: if shop management does support incipient initiatives, it is in word alone.

It happened again this year, when Zhdanov steelmaker Twice Hero of Socialist Labor G. Ya. Gorban' came forth with the following initiative: "Conserve metal -- the grain of industry." Krivorozhstal' open-hearth shop worker A. M. Lushchiy had the following to say about this: "Gorban' generated a fine initiative. It applies to us as well, for we produce a lot of rejects. Party bureau secretary A. D. Drozd and shop superintendent V. N. Gurov stated that they would support this fine initiative. This gave it impetus. I reported the undertaking at a worker meeting and at a party meeting. Our brigade is presently working with practically zero rejects. I can say the same thing about our comrades on the neighboring furnaces -- steelmakers Stepan Bragar and Valentin Poznakos. As far as the shop as a whole is concerned, however, nothing has changed. Work without rejects has not become a mass movement. And yet this did not keep V. A. Yeremenko, chairman of the trade union shop committee, from reporting at a trade union report-election conference held recently that G. Ya. Gorban's initiative has been supported by the work force. As they say, things looked good on paper...."

The steelmakers have appealed time and again to the shop management: let's set up things right in this shop; let's get together with the blast-furnace and rolling-mill workers and talk things over. The supervisors agree, but that is as far as it goes.

Collecting dust somewhere in the trade union reports are the terms of competition between the blast-furnace workers and railroaders for turning out high-quality product at the lowest cost, and related competition for economical coke consumption. The labor competition of their colleagues, initiated under the slogan "From Mutual Complaints to Mutual Assistance," went nowhere. And how does the plant party organization respond to this? It certainly does not ignore critical problems. Sharp criticism is leveled and topical questions are frequently raised at meetings. As experience indicates, however, this is not enough in the prevailing situation. The main error of omission is a lack of adequate demandingness, militance, and aggressivenes.

Up to the present time party members have failed to take a firm position on matters of speeding up scientific and technological advance. And yet year after year new equipment and technology plans at the enterprise fail to be carried out, with implementation of only half of the targeted organizational-technical measures. In the last five years, for example, technical upgrading has failed to apply to the "bottlenecks" in blast furnace, steelmaking, and rolling mill operations. Stopperless steel pouring and one-piece ladle lining have not yet been adopted, and the manufacture of economical rolled products is being expanded very slowly. And this is at a time when other metallurgical enterprises have long since adopted new developments and are achieving considerable savings.

At the end of last year, according to the target assigned by the UkSSR Ministry of Ferrous Metallurgy, this plant's Blast-Furnace Shop No 1 was supposed to be processing blast-furnace slags by "mirror" frothing in the ladle. This required putting on-line two units which, experts conclude, do not present any difficulty. But these units are not in operation. Also proceeding slowly in this shop is modernization of the blast stoves and the process of bringing on-line a set of equipment for mechanized replacement of the skip cables.

The Odessa Rolling Mill workers stress in their letter that the Krivorozhstal' metallurgical workers have for a long period of time now been failing to fill their order for rolled stock made of SvO8G2S steel. This applies first and foremost to the open-hearth shop workers and, incidentally, is inseparable from their adoption of new equipment. Approximately 35 percent of the steel of this grade produced in the two-basin units of the open-hearth shop is marked down to a lower grade of steel following inspection by the technical inspection division. In the language of the process engineers, this happens "due to failure to meet the specifications of chemical analysis by reason of nonuniform vertical distribution of silicon and manganese in the ladle." But simple things stand behind these terms: in order to reduce the percentage of failure to meet specifications, the open-hearth operators must preliminarily fire the ferroalloys charged into the ladle. Then, on the one hand, there will not occur above-standard overconsumption of extremely short-supply addition agents, and on the other hand orders can be filled without delays, without letting down partners. Two years ago party committee secretary V. Ye. Pron'kin spoke about this in addressing a meeting of party-economic activists, but nothing has changed since that time.

The effectiveness of economic activity depends to a significant degree on skilled production management. This is an axiom. Consequently, the work style of the plant management should be distinguished by a businesslike nature, efficiency, and well organized verification. We must state, however, that many supervisory personnel of the plant's engineering services frequently do not know how to analyze thoroughly, comprehensively and purposefully to resolve problems which arise and to carry things through.

At the beginning of the year the party committee requested that the principal specialists analyze their errors in the last five years and draw up a program of action for each subdivision for the 11th Five-Year Plan. The same assignment was given to the plant's headquarters -- the production department. But department personnel conscientiously enumerated deficiencies for the principal shops, but forgot about their own shortcomings. And there have been plenty of these: the dispatcher service is substandard, 10-day and monthly planning is poorly organized, the department is drowning in routine tasks, is failing to study the basic causes of failure to meet production schedules, and is failing to take prompt measures to correct them.

A. A. Chekeres has been here five years as deputy chief of the production department for sintering and blast-furnace production. But he has not yet been able to solve a single basic problem pertaining to stabilizing blast-furnace shop operations. Nor are certain other department personnel distinguished by particular zeal, a department which, incidentally, has been without a person in charge for almost a year.

Recently the people at Krivorozhstal' have frequently mentioned a new experiment in work with personnel at Magnitka. Several delegations visited the Urals, and considerable money has been spent, but practically no results have been achieved. Still more people are quitting their job at this enterprise than are being hired. Since this beginning of this year more than 1,000 persons 25 years of age or younger have quit their job here, and almost one third of these had been employed here less than a year.

Not only young people are leaving. Recently there have been a large number of persons with six or seven years on the job who have quit. The reasons vary, but the main reason is dissatisfaction with working conditions and the fact that people's needs and desires are ignored. A recent sociological study in Converter Shop No 1 revealed that workers are also quitting through the fault of certain supervisory personnel. The survey indicated in particular that shop superintendent Yu. V. Bashmakov is rude to subordinates and ignores comments and suggestions made at meetings. Can one expect from such a supervisor a correct understanding of personnel policy?

The establishment of stable work forces is a complex process, requiring much organizational effort and a sensitive attitude toward people. Orders and commands alone will not help. It is necessary that adoption of the Magnitka experience in working with personnel be accomplished in every shop and in every section.

...The following appeal draws one's attention at the plant entrance: "Comrades! Let us rebuild the labor fame of Krivorozhstal'!" Today this thought is uppermost in the minds of all the many thousands of persons employed at this huge metallurgical enterprise. There are possibilities of attaining the goal, and if they are intelligently utilized, one must assume that Krivorozhstal' will once again take its rightful place as a leader of this republic's iron and steel industry.

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POSSIBLE INFLUENCE OF CRYOGENIC PROCESSES ON REDISTRIBUTION OF GOLD IN PLACERS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 260, No 1, Sep-Oct 81
(manuscript received 22 Dec 80) pp 202-205

MITROFANOV, A. I., POGREBNYAK, Yu. F. and KOROLEVA, G. P., Geologic Institute, Buryatsk Branch, Siberian Division, USSR Academy of Sciences, Ulan-Ude

[Abstract] An experimental study was made of the possibility of influence of cryogenic processes on redistribution of gold in the mobile substrate with formation of independent segregations (nuggets). The experiments were performed by placing mixtures of particles of quartz and goethite with gold on their surfaces in test tubes, washing the specimens with distilled water and retaining the specimens for 6 months, then measuring the distribution of the gold through the height of the test tubes by measuring the quantity of radioactively labeled (^{195}Au) gold. Least diffusion of gold occurred in constantly frozen columns. Great migration was noted in a system which was not frozen, with gold accumulating at the level of a gold wire screen. The greatest transfer of gold and maximum accumulation at the level of the screen were observed in a column which was periodically frozen and thawed. It is assumed that when a sorption system consisting of a solid phase plus water containing gold is thawed, active desorption occurs, from the surface of the mineral particles with transition into the solution where the gold may diffuse in the direction of its least concentration by a certain distance. Figures 1; references 8: all Russian.
[17-6508]

UDC: 552.162:553.411

NEW TYPE OF GOLD ORE FORMATION IN ALKALINE METASOMATITES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 260, No 1, Sep-Oct 81
(manuscript received 1 Dec 80) pp 179-182

KOROBEYNIKOV, A. F., Tomsk Polytechnical Institute imeni S. M. Kirov

[Abstract] Alkaline autometasomatosis has been discovered in inversion and orogenous stages of development of folded areas of the Sayan-Altay and Tyan'-Shan' areas, with accompanying veins of gold-quartz ore formation. Quartz-albite metasomatites are common under the same conditions, but usually form external zones of potassium metasomatosis or intersecting metasomatic bodies up to 1.5 km in length and 20-500 m in width. In the upper Mansk region of eastern Sayan albitized and greisenized dikes of syenite-porphyry of early Paleozoic age have been found. In the central Transbaikal, late Jurassic magmatism occurred forming intrusions and dikes of diorite composition, genetically related to gold-bearing metasomatites. Gold-bearing albite rock has also been found in central Asia, the southern Urals, the southern Ukrainian shield and other foreign territories. The appearance of gold-bearing albite metasomatites is usually related to the development of orogenous granite, and diorite intrusive complexes with characteristic sodium-chlorine geochemical specialization of fluids or formation can be considered the final stage of a single process of alkaline metasomatosis. The main specifics of the type of gold ore formation here described are: 1) spatial association with zones of albitization of granitoids with areas of negative anomalies of gold and accompanying Ag, Bi, Cu, As, Pb and Mo; 2) colocation of molybdenum and gold mineralization; 3) regular sequential development of mineral paragenesis of albitites, greisens, berisites and ores; 4) relatively high temperature of albitizing and ore-forming solutions; 5) predominant inclusion-vein type of gold and rare metal ore formation; 6) colocation of richest gold mineralization with areas of maximum albitization and quartz formation; and 7) appearance of this type of gold ore in orogenous and activated crustal structures with active development of granitoid intrusions with sodium-chlorine or sodium-chlorine-fluorine specialization of fluids. Consequently, in gold-bearing regions with broad manifestation of orogenous granitoid magmatism, quartz-albite metasomatites may contain gold and should therefore be particularly carefully studied.
[17-6508]

UDC: 669.721.48

PRODUCTION OF GRANULATED MAGNESIUM FROM SECONDARY MAGNESIUM ALLOYS

Moscow TSVETNYYE MATALLY in Russian No 10, Oct 81 pp 84-87

BARANNIK, I. A., POLOUS, V. A. and TRUKHIN, A. F.

[Abstract] Studies were performed involving the technology of the production of granules from secondary magnesium alloy in the magnesium-aluminum-zinc system using an apparatus and technology developed earlier for the production of granules of primary magnesium. The first experiments utilized a perforated vessel with aperture diameter 1.8 mm and VI2 flux as the salt additive. Further studies were performed on an experimental granulation installation differing primarily in that the metal was poured from a special furnace above the granulator through a siphon device. The salt additive used was a spent electrolyte with the addition of 5 to 10% $BaCl_2$. The distribution of magnesium granules by radius, influence of frequency of rotation of the perforated vessel on particle-size distribution of the product and granulation conditions were studied. The possibility was demonstrated of producing granulated magnesium from secondary magnesium alloy. The granules were tested by potential consumers. Properties of granulated magnesium are presented in tabular form. References 7: all Russian.
[43-6508]

NONFERROUS METALLURGY

NON-FERROUS METALLURGY MAJOR AREA OF KaSSR DEVELOPMENT

[Editorial Report] Alma-Ata SOTSIALISTIK QAZAQSTAN in Kazakh 17 September carries on page 3 a 1,200-word article by P. Islamov, head of the Non-Ferrou and Ferrous Metallurgy Division of the KaSSR State Planning Commission, entitled "Non-Ferrous Metallurgy in the KaSSR" and published under the regular rubric "Study of the Basic Directions " Islamov begins by stressing the fact that non-ferrous metallurgy is of crucial importance for industry and has been the object of considerable investment in the Soviet Union (2.1 billion rubles in the KaSSR during the current five-year plan) and much emphasis in present planning. He then goes on to review the present state of KaSSR non-ferrous metallurgy, plant by plant, emphasizing the many new facilities and new technology, employed primarily in co-ordinated extraction of several or all possible products from an ore and to maintain yields in the face of declining metal contents of ores. One problem area seems to be adequate sulphuric acid supplies.

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COMPREHENSIVE UTILIZATION OF NONFERROUS METAL ORES

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 5, Sep-Oct 81 pp 5-12

[Article by A. P. Snurnikov: "Principal Directions in Solving Problems of Total Utilization of Raw Materials in Nonferrous Metallurgy in the 11th Five-Year Plan"]

[Text] Our country devotes considerable attention to efficient utilization of commercial mineral deposits. Mineral resources demand a particularly thrifty attitude since, in contrast to other natural resources, they are not renewable but gradually become exhausted. On the other hand, material and labor expenditures on extracting mineral raw materials are constantly increasing. This is due to the fact that deposits located at considerable depths are being worked, and this requires digging deep open-pit and underground mines; new deposits are being mined in northern, remote and difficult-access regions; reserves of rich and readily beneficiated ores are becoming exhausted, which makes it necessary to process ores with a lower content of valuable constituents, occurring in more difficult mining-geologic conditions, and difficult to beneficiate using current methods.

One of the principal ways of solving the problem of mineral-raw materials base, increasing profitability of mining production, and satisfying the requirements of the nation's economy in various fuels, chemical raw materials, ferrous, nonferrous, and rare metals is the combined and fullest possible utilization of commercial mineral deposits and, correspondingly, extracted mineral raw materials.

The Communist Party and Soviet Government have raised the problem of comprehensive utilization of raw materials to the level of state technical policy. Special attention is focused on the problem of combined utilization of raw ore in nonferrous metallurgy, which is due to the comprehensive significance of ferrous metallurgical products for the nation's economy and technological advance in the economy.

In November 1972 a CPSU Central Committee decree was issued, entitled "On the Work of the Party Organizations of the Ust'-Kamenogorsk Lead-Zinc and the Balkhash Mining and Metallurgical Combines to Mobilize the Work Forces to Achieve Excellent Performance Figures in Comprehensive Utilization of Ore Raw Materials." The decree stated that fuller and more comprehensive utilization of raw ore is a most important factor in expanding resources for production of nonferrous metals and reducing expenditures per unit of product and helps prevent pollution of the environment with industrial waste.

To satisfy the requirements of the economy in nonferrous and rare metals, it is necessary to extract each year more than 2 billion tons of rock, to consume tens of billions of kilowatt hours of electric power, approximately 6 billion cubic meters of natural gas, approximately 25 million tons of standard fuel, 3 billion cubic meters of water, almost 2 billion cubic meters of oxygen, and millions of tons of various materials. Production costs in all process operations of the nonferrous metallurgical industry total many billions of rubles each year. Naturally with such a large scale of production the economic effectiveness obtained from fuller recovery of the principal metals and by-product extraction of other valuable constituents increases sharply. According to the figures of leading nonferrous metallurgical enterprises, sale of by-products obtained as a result of comprehensive utilization of raw materials during metallurgical processing, generates from 30 to 50 percent of an enterprise's total profits.

The ores of nonferrous and rare metals are usually of complex composition, and many secondary constituents exceed the value of the principal constituents. In many cases organization of production of rare elements (selenium, tellurium, indium, rhenium, gallium, scandium, thallium, hafnium, and rubidium) is possible only as a result of comprehensive processing of the ores with incidental recovery of the indicated constituents. Therefore comprehensive processing of raw ore in the nonferrous metallurgical industry is of great national importance for providing many branches of industry with rare and scattered metals and semiconductor materials. In various hydrometallurgical production operations (zinc, copper, nickel, etc), recovery of valuable incidental constituents from the solutions when cleaning the latter of impurities also ensures improved quality of the metals and a reduction in specific consumption of electric power.

The great social significance of comprehensive utilization of raw materials is also due to the demands of Soviet laws pertaining to environmental protection -- against air pollution, water pollution, and pollution of the land surface.

Beneficiation and metallurgical enterprises are one of the major sources of polluting the air and water with harmful stack gases and industrial effluents. Recovery of valuable constituents contained in stack gases makes it possible simultaneously to render them harmless and promote cleaner air in the vicinity of metallurgical enterprises. Construction of wastewater treatment plants and adoption of closed-cycle water utilization at concentration mills and plants offers the possibility of additional extraction of valuable elements from wastewater and at the same time to prevent pollution of the rivers and seas with harmful substances.

The problem of comprehensive utilization of raw materials in the nonferrous metallurgical industry is a rather complex scientific and technical task, solution of which requires enlistment of the entire arsenal of modern technical means and is closely linked with improving production equipment and processes.

Measures pertaining to achieving fuller utilization of raw materials are incorporated in the comprehensive program of technological development of nonferrous metallurgy for 1976-1985 and constitute one of its most important sections.

In the 10th Five-Year Plan nonferrous metallurgy developed in conformity with the resolutions of the 25th CPSU Congress. During this period the enterprises of this branch of industry turned out product worth many billions of rubles more than in the 9th Five-Year Plan. There was an increase in the production of aluminum, titanium, nickel, magnesium, and other valuable materials. There was a substantial increase in the production of semiconductor materials, rare metals, hard-alloy and carbon-graphite products, sulfuric acid and phosphate fertilizers. An important role in the development of nonferrous metallurgy and in increasing the economic effectiveness of its production was played by measures of technological advance, including measures connected with the problem of achieving more complete utilization of raw materials.

Concentrating mills have adopted ore self-grinding techniques, methods of preliminary concentration in heavy media, a sorption-filtrationless process for extracting gold, collective-selective flotation arrangements with employment of new reagents, as well as advanced gravity separation and flotation equipment, which as an aggregate achieves greater recovery of metals, fuller utilization of raw materials, and higher labor productivity.

The volume of ore processing with employment of concentration in heavy media and other advanced methods of preliminary concentration increased by 70 percent during the five-year plan, while volume of ore self-grinding increased by 60 percent. Adoption of the process of concentrating ores in heavy media at the Leninogorsk Combine made it possible to remove up to 30 percent of waste rock from the ore at the coarse crushing stage and to increase recovery of lead and zinc during subsequent flotation concentration. Employment of self-grinding of certain types of ores has reduced their overgrinding in reaching the minerals and has reduced losses of valuable constituents with tailings. Volume of processing of ores and concentrates by the sorption-filtrationless method more than doubled. A new gold recovery process is based on cyanide leaching of gold from ores with subsequent sorption from pulp by ion-exchange resins and eliminates the laborious and energy-intensive operation of pulp filtration.

There has been an increase in the volume of ore concentration with improved flotation arrangements. The innovative technique employed by the Balkhash Combine, coarsening the grind at the beginning of the process (in order to reduce sludging) and additional recovery of metals from the sand fraction of the tailings has been more widely adopted. A similar process has been incorporated at the Dzhezkazgan and Leninogorsk mills, and partially at the Almalyk mill. At the same time new equipment was being installed at concentrating mills, in particular large flotation machines with a chamber volume of 12, 16, and 40 m^3.

In the production of heavy nonferrous metals there has been an increase in the scale of processes based on utilization of oxygen. Oxygen is employed as an intensifier in the reverberatory smelting of copper concentrates at the Balkhash, Noril'sk, and Almalyk combines, in shaft-furnace lead smelting at the Chimkent Plant, the Ust'-Kamenogorsk Combine, the Elektrotsink Plant, and in roasting zinc concentrates at all zinc plants other than the Belovo and the Ukrtsink Plant. Oxygen is particularly important in autogenous processes, since it makes it possible more fully to utilize the calorific power of sulfides and to smelt copper, nickel, and lead concentrates with practically no consumption of carbonaceous fuel.

Until recently melting of copper cathodes into wire bars was performed only in low-output internally fired furnaces and involved difficult working conditions. The special design office for heavy nonferrous metals attached to the Gintsvetmet Institute and the Uralelektromed' Combine have successfully produced a new design and process for automating melting of copper cathodes in a shaft furnace fired by natural gas.

Hydrometallurgical processes have also undergone development. The Noril'sk Combine has put into operation the first unit of the Nadezhda Plant, which employs a hydrometallurgical autoclave process for pyrrhotite concentrates, producing copper-nickel product and merchantable sulfur. An experimental full-scale hydrometallurgical process for zinc cake has been developed at the Leninogorsk Complex Ore Combine. A full-scale shop employing this scheme is presently being brought on-line. The Tajik Aluminum Plant has put into operation electrolysis buildings equipped with modern automated electrolytic cells with calcined anodes, operating at 160-175 kiloamps. The electrolytic cells boast a lower specific electric power consumption and discharge smaller amounts of pollutants into the atmosphere. Magnesium production has been fully converted over to cathode-boxless electrolytic cells, which boast greater output and which reduce consumption of electricity.

Measures have also been taken to develop continuous and combined casting and rolling processes, which make it possible to produce rolled stock directly from molten metal. At the present time these methods are being employed to produce ingots of aluminum and brass, bronze, brass, zinc, and aluminum wire rod, rod and tube billets from nonferrous metal scrap. Production volume with employment of these advanced processes increased by more than 20 percent during the five-year plan. These processes, in addition to increasing labor productivity, make it possible to reduce process waste by 33-50 percent and irretrievable nonferrous metal losses by 20-30 percent. Considerable organizational and technical work has been accomplished at the enterprises of this branch in the area of utilizing internal reserve potential for more efficient processing of raw materials.

There has been an increase in the branch average figure for recovery of metals and sulfur in metallurgical production. Many metallurgical plants have become leaders in degree of recovery and completeness of utilization of raw materials. A number of metallurgical enterprises are operating according to a waste-free process. For example, solid intermediate products at the Chelyabinsk Zinc Plant -- lead cake, clinker, in which lead, copper and precious metals are concentrated -- are shipped off to lead and copper plants for processing, while gases containing sulfur dioxide are used to obtain sulfuric acid with a double contact-double absorption arrangement, which achieves fuller sulfur recovery. The closed-cycle water utilization at the plant eliminates losses of metals with wastewater. Recovery of zinc to finished product amounts to 96.85 percent.

The copper plant at the Dzhezkazgan Mining and Metallurgical Combine employs an advanced electric smelting process -- Bessemerizing -- and has the highest copper recovery figure of all Soviet copper plants (98 percent). The combine employs secondary recovery of valuable elements from copper smelting operation waste gases. The Volkhov Aluminum Plant, at which solid waste is utilized to produce cement, also operates on a practically waste-free process.

Volume of processing of zinc-containing slags, clinker, cake and other intermediate products and production waste accumulated in dumps in recent years has increased considerably. During the 10th Five-Year Plan the volume of processing of zinc-containing lead slags increased by 60 percent. In 1980 almost 200,000 tons more nonferrous metal scrap and waste was procured than in 1975. As a result of this, during the five-year plan there was a substantial increase in volume of production of aluminum alloys and bronze.

We should state that change in the structure of raw ore in the direction of increase in complex ores which are difficult to concentrate, as well as off-balance sheet, old and oxidized ores with low content of valuable constituents had a negative effect on branch average figures on recovery of metals during ore concentration. At the same time a number of mills, possessing a more stable ore base, achieved considerable success in boosting metal recovery figures, including the Sorsk (copper by 3.77 percent, molybdenum by 0.26 percent), Uchaly (copper by 2.77 percent, zinc by 2.25 percent, silver by 7.8 percent, sulfur by 6.34 percent), Urup (gold by 9.8 percent, copper by 1.57 percent), Solnechnaya (tin by 6.25 percent), and Kafan (copper by 1.97 percent).

During the 10th Five-Year Plan nonferrous metallurgical enterprises accomplished a great deal of work in the area of environmental protection, which made it possible, in spite of an overall production growth, to reduce by 275 million cubic meters per year in comparison with 1975 the consumption of fresh water for industrial needs, to reduce by 75 million m^3/year the amount of polluted effluents discharged into bodies of water, and to increase by 1 billion 230 million m^3/year the volume of closed-cycle and repeat-sequentially utilized water. More stack gases began to be treated to remove pollutants and recover valuable constituents. The concentration mill at the Verkhnedneprovsk Mining and Metallurgical Combine achieved considerable success in utilization of solid waste. This enterprise organized an operation whereby clean, high-quality quartz sand was produced from ore dressing tailings, sand which is extensively purchased by this country's machine building enterprises as molding material for advanced casting methods. Large quantities of slags from the Rezh Nickel Plant are consumed in production at the Sukhoy Log Cement Plant.

A great deal of work is to be accomplished in the 11th Five-Year Plan in the area of comprehensive utilization of deposits of nonferrous metals and raw ore. The resolutions of the 26th CPSU Congress, in the ratified Principal Directions, point to the necessity "of more complete exploitation of commercial mineral deposits, preventing mineral losses during mining and processing, ...improving the technology of mining and processing ores and concentrates, and achieving more complete utilization of mineral raw materials...." A most important and primary direction of emphasis in this work is a detailed study of ore bodies, ores, concentrates, overburden, concentrating mill tailings, intermediate products, as well as metallurgical production solid, liquid and gaseous waste.

Concentration of ores is the principal element in the technology of processing mineral raw materials. This process determines to a significant degree the completeness and comprehensiveness of utilization of raw materials and production technical-economic induces for the branch as a whole. This is due to the fact that at the present time practically all ores are subjected to concentration and do not go directly into metallurgical processes. Therefore those valuable ore constituents which were not extracted during dressing into concentrates and which remained in the discarded tailings are essentially irretrievably lost for many years. On the other hand, the quality of concentration products in turn also determines to a certain degree metals recovery indices in metallurgical production. Thus improvement of equipment and technology of ore dressing is totally focused on solving the problem of comprehensive utilization of raw materials.

Concentrating mill work forces are faced with highly complex tasks in the 11th Five-Year Plan. In connection with delay in bringing into production new nonferrous metal deposits, mining enterprises are mining low-grade, off-balance sheet ores, are working sections of ore bodies containing ores which are difficult to concentrate, and in many cases are processing substandard ores from tailings dumps. In the current five-year plan a 50 percent larger volume of such ores will be processed than in the 10th Five-Year Plan. For example, targeted for processing are increased volumes of low-grade ores at the Balkhash, Zyryanovsk, Leninogorsk, and Khrustal'nenskiy combines. In addition, ores which are up to standards but are difficult to concentrate are being processed at the Achisay, Noril'sk, Tyrnyauz, Primorsk and other combines.

Indices on complete utilization of raw ore at concentration mills will improve through improvement in dressing of ores, equipment, process and organization of production, and adoption of processes for extracting valuable accompanying constituents from ores; development of new methods of additional recovery of metals from tailings; development of methods of reducing losses of valuable constituents with process solutions and wastewater. Another decisive factor in improving the concentrating process will be the establishment of a close organic link between mining shops and concentrating mills.

Proceeding from an analysis of the technological level of concentration and the condition of basic equipment at concentrating mills, the following principal directions of scientific research and experimental work and organizational-technical measures for increasing recovery and completeness of utilization of raw materials in dressing operations have been drawn up.

First of all, measures will be taken to improve the accuracy of the estimate of ore reserves to be processed in coming years. To achieve this, there will be intensification of efforts at advance geologic mapping of ore bodies, there will be an increase in the volume of testing of representative samples on experimental equipment at enterprises and institutes, and new experimental concentrating mills will be constructed at the Zhayremskoye, Udokanskoye, Ozernoye, Boshchekul'skoye and other ore bodies.

In order to ensure that mills receive ore (ore mixture) of constant composition, Mekhanobr and other institutes were instructed to develop systems of controlling ore quality by blending. In order to improve ore preparation and to expose the minerals more fully prior to flotation, engineers are increasing the volume of preliminary concentration of ores in heavy media, ore grading and separation by various gravity and radiometric methods. Measures are also being taken to develop ore crushing techniques and equipment which produce a crushed product size in the range of 16-20 mm.

Efforts will also be made to obtain more efficient methods of washing and preparing clayey and compacted ores for flotation. Balless grinding of ores is also being employed on an expanded scale. Steps are being taken to supply concentrating mills with new, highly efficient and selectively acting nontoxic flotation reagents. Combined processes will be developed and tested for processing complex, hard-to-concentrate ores and collective commercially useful products of concentration, based on a combination of gravity, flotation, pyrometallurgical, hydrometallurgical, sorption and extraction operations.

Concentration mills will be outfitted with efficient, high-output equipment of large unit capacity (crushers, mills, flotation machines, gravity separating equipment).

The principal metal losses in pyrometallurgical production occur with dump slags, stack gases and particulates, and at enterprises with hydrometallurgical technology -- with solid waste and effluents. Fuller recovery of valuable constituents is obtained at those plants where less waste, stack gases and industrial effluents are generated. The best results are obtained at enterprises employing processes which are close to waste-free.

In the current five-year plan, proceeding from the experience amassed by nonferrous metallurgical enterprises and institutes in the comprehensive utilization of raw materials, work will continue in the following areas:

increasing the direct recovery of valuable constituents as merchantable products;

comprehensive processing of the collective products of ore concentration and metallurgical production intermediate products;

improvement of trapping of particulates and scrubbing of stack gases, with processing of trapped particulates and recovery of scrubbed products;

additional recovery of metals from waste dump products;

organization of closed-cycle water utilization, treatment of industrial effluents with recovery of valuable constituents.

Accomplishment of the first task is closely linked with development and adoption of improved industrial processes. In the production of heavy nonferrous metals these include autogenous and electrothermal processes, hydrometallurgical, including autoclave technology with extensive employment of sorption and extraction. In particular, plans call for building and bringing on-line in 1981-1985 as many as 10 autogenous units for processing copper, nickel, and lead concentrates. A prominent place among this equipment is occupied by installations for liquid-bath smelting of sulfide raw material, targeted for construction at the Noril'sk and Balkhash combines and at the Sredneural'sk Copper Smelting Plant.

Combined processes are being developed for the comprehensive processing of collective materials, in which a dominant role will be played by hydrometallurgical operations. Such materials include copper concentrates at the Solnechnyy Mining and Concentration Combine, intermediate products of concentration of Ural copper-zinc ores, zinc cake, clinker, and other such products. Measures are being taken to improve particulate-trapping and gas-scrubbing installations, with the aim of increasing their efficiency. New systems of bag-type filters and electrostatic precipitators are being developed, as well as equipment for treating the waste gases of sulfuric acid and other shops at chemical plants.

Considerable attention is being devoted to projects aimed at increasing the volume of processing of slags, in particular zinc-containing lead slags, slags and waste from final concentration in tin production, as well as other metallurgical waste. When the large Waelz process installation for processing zinc-containing slags comes on-line at the Leninogorsk Complex Ore Combine, the volume of processing of this waste will almost double by the end of the five-year plan.

Much attention will be devoted to environmental protection measures and the development of waste-free technology in metallurgical production. The most promising in this regard are enterprises of the lead-zinc and copper industry, titanium and aluminum plants (processing nephelite). Production of elementary sulfur by reducing sulfur dioxide in metallurgical stack gases with natural gas will be set up at the enterprises of the Noril'sk Combine. An important role in carrying out highly complex tasks pertaining to solving the problem of comprehensive utilization of raw materials is being assigned to nonferrous metallurgy scientific research and design institutes. It is their task to design and engineer new, more advanced technologies for processing low-grade ores, intermediate products and production waste.

Providing nonferrous metallurgical enterprises with raw materials, efficient and comprehensive utilization of these materials is a task of national importance, and the manpower and resources of all subdivisions of the Ministry of Nonferrous Metallurgy, nonferrous metallurgical enterprises and organizations will be concentrated on accomplishing this task.

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3024
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AUTOMATION OF PLANNING AND ACCOUNTING FOR PREPARATION OF SCRAP AND WASTE OF NONFERROUS METALS

Moscow TSVETNYYE METALLY in Russian No 11, Nov 81 pp 56-57

IZYUMSKIY, F. P., SAVENKOV, G. V. and SAVRUKOVA, G. D.

[Abstract] The primary task of "Vtortsvetmet" (VTSM) is recycling of nonferrous scrap metal. Over 10,000 man hours per year are expended in the calculations involved in this administrative process. Work has now been performed on automation of the control of preparation of scrap and nonferrous metal waste by computers for purposes of technical and economic planning, accounting and bookkeeping involved in this process. The system of coding which has been developed and the presence in machine memory of standard reference information reduces the volume of initial data which must be input to the computer for specific calculations. The system of programs which has been developed for the computer system allows operational accounting of quantities of metal recycled per day, quarter to date and year to date. The control system has been designed to operate with various types of data input devices. The system was introduced in 1978-1980 at 5 enterprises of VTSM, achieving a savings of 350,000 rubles. It is planned for installation at 7 additional VTSM administrations and unions in 1980-1981. [51-6508]

POWDER METALLURGY

POWDER METALLURGY PROBLEMS AT DNEPROSPETSSTAL' PLANT

Kiev RADYANS'KA UKRAYINA in Ukrainian 24 Oct 81 p 2

[Article by RADYANS'KA UKRAYINA special correspondent M. Soroka, Zaporozh'ye: "In a Series of Reprimands"]

[Text] A curious story was related to me at the Dneprospetsstal' Plant. Bypassing all intermediate levels, the USSR Ministry of Ferrous Metallurgy directly reprimanded S. V. Revyakin, a shop superintendent at this enterprise. The reason for the reprimand was the fact that F. V. Revyakin's shop has in recent months been consistently failing to meet plan targets.

As we can see, there is serious reason for the reprimand. But why is metallurgical industry headquarters focusing specific attention only on this shop? In seeking an answer to this question, it would surely make sense to begin with the history of establishment of this shop at Dneprospetsstal'. It is a short one. It has been less than a year since the powder metallurgy shop was accepted by the State Commission and proceeded to put out its first series production. The labor force worked smoothly and with precision from December of last year to the spring of this year. At that time there was no cause for alarm, particularly since the first and most important steps along the road of getting the new facility into full production were now behind, it seemed.

But whoever was of this opinion was sadly mistaken. This was confirmed by the performance figures for the second quarter. The shop suddenly took sick. There began a series of frequent stoppages and equipment breakdowns. Monthly targets were not being met. Nor did the situation change in the third quarter.

That is the story. But it will be of little help to us in explaining the situation which has developed in this shop if we do not discuss the nature of this production and the specific features of its products. The new shop at Dneprospetsstal' is new not only by age: its technology is also quite new to the plant. The shop produces high-speed steel with the aid of an advanced powder metallurgy method.

"Small-scale metallurgy with a great future" -- this is what they are saying today about powder metallurgy. And it is scarcely likely that this will appear to anybody as an exaggeration: sintered powder machine parts are resistant to wear, to corrosion, and are durable, qualities which convince one of the advanced nature of this trend in metallurgy more eloquently than any words could do.

One of the promising areas of powder metallurgy is the production of high-speed steels by the method of spraying liquid melts with their subsequent compaction. In Zaporozh'ye, in one of the buildings of the Ukrainian Scientific Research Institute of Special Steels, Alloys and Ferroalloys, I was shown equipment on which this method is being studied and put to the practical test. It is a small induction furnace. In this furnace institute scientists melt steel of a specified composition, after which the metal, heated to a temperature of 1600°, is transferred into an intermediate hopper. The molten metal is fed from this hopper through a narrow aperture into a sprayer nozzle device, which is mounted in the upper part of a spray chamber. Here the stream of metal interacts with a flow of a gaseous energy carrier (nitrogen), breaks up and is transformed into tiny droplets, which solidify as they fall. They collect on the bottom of the chamber in the form of solid spherical particles. These are the metal powder. After final cooling, the powder is poured into special capsules, packed tight, and subjected to vacuum-thermal degassing. The final stage includes sealing and hot molding the powder in a unit called a gasostat. Scientists obtain as a result a high-grade steel, products made of which, cutting tools, for example, are distinguished by great durability and capability to operate in extreme conditions.

This process is taking place within the walls of the institute. In the powder metallurgy shop at Dneprospetsstal', which we visited with the head of the institute laboratory, M. Makohon, I saw a similar process. The only difference was the scale involved. For example, the capsules with molded powder were several dozen times larger than those I was shown at the institute. There is also one more important difference: the equipment at the institute was intended for scientific experiments, while here the equipment was for large-series production, turning out products for specific customers. The shop is supposed to produce 1500 tons of short-supply metal this year, and 2600 tons next year (this is the designed production figure). These figures are not very impressive at first glance, but let us consider the unique nature of production and its unusual complexity.

As regards the uniqueness of the shop, we should also add that in respect to technical parameters and scale of production, it has no equal either in this country or abroad. This means that when they proceeded to bring the new shop into production, the Dneprospetsstal' people could not take advantage of the experience of others and thus make their task easier. There is simply no experience available.

To explain current interruptions in shop operations as being due solely to this situation, however, would be contrary to the truth. The point is not only that the Zaporozh'ye people are blazing a pioneer path. The reader unquestionably noted that in the first quarter of this year the shop labor force worked in a stable manner, with the series of breakdowns beginning unexpectedly at a later date. Why did this happen? Because individual equipment components began to wear out and break down. There is nothing surprising about that: a substantial portion of the shop's equipment is operating in extreme conditions -- at very high temperatures and pressures. One is amazed by something else: why did they not take this into consideration in a timely manner, and why were replacement parts not readied in advance?

On the day we visited the shop, for example, shop specialists were busy repairing the gasostat. The heaters and ceramic insulation had failed. They explained to me that this was not the first time the shop had shut down for that reason. The

Min'var Metal Products and Metallurgical Plant began shipping heaters to this plant with great delay. And their quality is not very good at the present time. Similar complaints can be made against the manufacturer of the ceramic insulation -- the Ukrainian Scientific Research Institute of Refractories.

About a dozen capsules, filled with packed-down metal powder, stood alongside the disassembled gasostat furnace. Each capsule was taller than the average person. I learned that not all the capsules were suited for further use. Some of the capsules even contained defects which were evident to the untrained eye.

"That is not the worst of it," the deputy superintendent of the powder metallurgy shop, O. Yatsenko, said bitterly. "You should visit our initial processing department -- there are considerably more reject capsules there."

Statistics indicate that more than half of the capsules which come to the shop are unusable. That is not such a serious problem if the defect is spotted before the capsules are put to work. But frequently defects become evident just before the powder is hot molded, that is, after time, electricity, and materials have been expended.

The capsules are made in Dnepropetrovsk, at the experimental-research plant of the All-Union Pipe and Tube Scientific Research Institute. We should add to the losses which occur in the Dneprospetsstal' shop due to the poor quality of the capsules the cost of their manufacture and shipping. This problem with the capsules has existed for some time. Time goes on, but it has not yet been resolved. There are also a number of other difficulties which cannot help but affect shop operations. The charge is not always of good quality. The loading bins frequently malfunction.... It would be incorrect to state that in this situation the shop work force and shop supervisors have stood around doing nothing. They are endeavoring to find ways to end this series of setbacks. The institute is also lending the shop its "shoulder." Scientists from the Ukrainian Scientific Research Institute for Specialty Steel frequently visit the shop and are well acquainted with the difficulties which occur there.

"Every Tuesday somebody from the institute, most frequently officials from the department of powder metallurgy, attend our working conferences," shop superintendent S. V. Revyakin emphasized in his conversation with me.

Of course it is a good thing that the shop specialists have such highly qualified assistants and consultants. It is not every shop or every plant which can today boast of such scientific support. Nevertheless, even this is not helping, for resolving the problems which are of vital importance to the new shop depends not only on the enterprise and the institute. They can be resolved only with the assistance of top officials of the metallurgical industry.

Frequently one hears about so-called "interministerial barriers." They are used as reasons for various acute production situations which arise in relations between subcontractor organizations belonging to different ministries and agencies. The situation which developed in the powder metallurgy shop at Dneprospetsstal', however, cannot be blamed on "interministerial barriers": practically all the subcontractors involved in the new shop, just as the shop itself, are under the USSR Ministry of Ferrous Metallurgy. Thus it remains for this industry's headquarters to put its own house in order, so to speak.

And one must hope that this will be accomplished. But with great delay and at great cost! The decision to build the shop was made at the beginning of the last five-year plan. If the Ministry of Ferrous Metallurgy had figured and considered in a timely manner all problems connected with the new Dneprospetsstal' production, today this industry's top officials would not have to solve the problem with the aid of... reprimands.

3024
CSO: 1842/25

UDC: 621.762.5

SPECIFICS OF SINTERING PROCESS OF POROUS PRODUCTS OF METAL FIBERS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 11, Nov 81 (manuscript received 3 Apr 81) pp 21-24

KOSTORNOV, A. G., FEDOROVA, N. Ye. and CHERNYSHEV, L. I., Institute of Material Science Problems, Ukrainian Academy of Sciences

[Abstract] Studies were performed of the process of sintering of products of metal fiber and an attempt was made to explain the specific volumetric changes observed in this case. Specimens were manufactured from fibers 50 μm in diameter and 3 mm in length obtained from copper, nickel and molybdenum wire. These metals were selected due to the great differences in the relationships of rigidity and flexibility of the initial fibers. After pressing, the specimens were heated to intervals of 100°C as follows: the copper specimens to 1000°C in hydrogen and argon; the nickel to 1200°C in hydrogen; and the molybdenum to 1800°C (to 1200°C in hydrogen, to 1500 and 1800°C in a vacuum). After each heating the volumetric changes and porosity of the specimens were determined, as well as their resistivity. As heating temperature of the specimens increased, a decrease was observed in resistivity regardless of the nature of volumetric changes. This results from the fact that fiber specimens may contain two types of contacts between particles, one of which is destroyed during the process of volumetric growth. Estimates of the mechanical properties of fiber products based on changes in resistivity are therefore incorrect. Figures 1; references 5: all Russian.
[52-6508]

UDC: 621.762

PRODUCTION OF POWDERS OF VT20 and VT9 TITANIUM ALLOYS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 11, Nov 81 (manuscript received 15 Mar 81) pp 1-6

AKSENOV, G. I., KRYUKOV, V. I. and KAZAKOV, V. N., Kuybyshev Aviation Institute

[Abstract] A study is made of hydrogenation-dehydrogenation processes, the possibility of production of VT20 and VT9 powders, manufacture of blanks and parts from them and the properties of the powders and alloys produced. The initial materials were conditioned, i.e., slightly oxidized wastes, hydrogenated in sealed reactors (muffle furnaces) at 673-973°K for 10-30 minutes, hydrogen pressure in the system $505\text{-}1515 \cdot 10^2$ Pa. The muffle and hydride were then cooled in still air. The hydrogenation-dehydrogenation method produces powders of commercial titanium alloys, the chemical composition of which corresponds to the technical standards for VT20 and VT9. The processes involved cause a change in the phase composition and structure of the alloys: the quantity of β phase decreases, and the structure becomes finer in grain. Figures 3; references 10: all Russian.
[52-6508]

UDC: 621.762:621.193:669.295'721

CORROSION RESISTANCE OF TITANOMAGNESIUM PSEUDO-ALLOYS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 11, Nov 81 (manuscript received 28 Nov 80) pp 85-87

FRANTSEVICH, I. N., KARPINOS, D. M., YAGUPOL'SKAYA, L. N., TUCHINSKIY, L. I., SAPOZHNIKOVA, A. B. and DZEGANOVSKIY, V. P., Institute of Material Science Problems, Ukrainian Academy of Sciences

[Abstract] A description is presented of the influence of the composition of Ti-Mg pseudo-alloys on their corrosion properties. The studies were performed on materials obtained by saturation containing from 10 to 40 vol.% magnesium alloy. Type PTS calcium hydride powder with particle diameter between 0.28 and 0.04 mm was used to manufacture the porous titanium framework. Saturation was performed with IMV-3 cast magnesium alloy. Corrosion processes were studied under laboratory conditions on the basis of mass loss in a 3% NaCl and 50% KOH solution over 300-400 hrs at room temperature and by determination of electrochemical characteristics based on anode curves measured potentiodynamically with a rate of change of potential of 3.6 V/hr. The laboratory studies of the corrosion resistance of titanium-magnesium pseudo-alloys agrees with the results of field testing in the tropics and subtropics. The study of corrosion and electrochemical

properties of titanium-magnesium pseudo-alloys under laboratory and field conditions shows that the rate of corrosion of the magnesium phase in compositions with titanium with a content of 35-40 vol.% is 1 to 2 orders of magnitude lower than that of pure magnesium alloy. The increase in corrosion resistance of the magnesium component is apparently facilitated by its saturation with titanium to the limit of solubility. Figures 1; references 4: all Russian.
[52-6508]

UDC: 621.793.042:621.793.72.011:533.9

STRUCTURE AND PROPERTIES OF MATERIALS AND COATINGS OF CHROME-CARBIDE COMPOSITES

Kiev POROSHKOVAYA METALLURGIYA in Russian No 11, Nov 81 (manuscript received after revision 30 Mar 81) pp 74-80

TREFIKOV, V. I., BORISOV, Yu. S., ALFINTSEVA, R. A., GORBATOV, I. N. and PUSHKAREV, V. V., Institute of Material Science Problems, Ukrainian Academy of Sciences

[Abstract] The use of the methods of casting, sintering and hot pressing of products of alloys in the systems Cr-TiC and Cr-ZrC is in many cases difficult due to technological complications in the manufacture of parts of complex shape. These materials may also be insufficiently ductile and have low impact toughness, particularly at low temperatures. There is therefore interest in use of these materials as coatings on stronger, more plastic bases. The method of plasma-arc atomization is used to produce coatings. One of the main criteria determining the suitability of a material for gas thermal application is the parameter D "difficulty of melting" in a high-temperature jet. Eutectic compositions have minimum D. Cast alloys based on chromium containing TiC, TaC and NbC, were studied to provide a comparative evaluation of the structure, phase composition and properties of compact materials and coatings. Eutectic chromium-carbide compositions are promising materials for use in the technology of plasma application of coatings. The plasma coatings are superior to sintered alloys of the same composition in their wear resistance. These coatings are most promising for practical application under high-temperature wear conditions in an oxidizing atmosphere in parts of metallurgical and energy equipment and in gas turbine engines. Figures 5; references 13: 9 Russian, 4 Western.
[52-6508]

UDC: 536.4:532.6

FORMATION OF MELT IN TITANIUM-ALUMINUM SYSTEM AT TEMPERATURE BELOW MELTING POINT OF ALUMINUM

Kiev POROSHKOVAYA METALLURGIYA in Russian No 10, Oct 81 (manuscript received 15 Dec 80) pp 83-85

SAVITSKIY, A. P., BURTSEV, N. N. and ZHDANOV, V. V., Siberian Institute of Physics and Technology

[Abstract] An attempt was made to detect the ΔT effect, the development of a melt in contact with dissimilar metals at an environmental temperature lower than the melting point of the lowest melting component in a peritect system in which intermetallides are formed but there is no eutectic. The experiments were performed on specimens pressed from a mixture of titanium and aluminum powders with particle diameters of less than 50 μm. Monitoring of the temperature within the specimen and outside it, as well as continuous measurement of the linear dimensions of the briquette during the course of heating and subsequent holding allow reliable determination not only of the fact of the melting of aluminum in contact with titanium due to heat liberated upon formation of the intermetallides, but also determination of the moment of appearance of the melt. Figures 1: references 10: 9 Russian, 1 Western.
[45-6508]

TITANIUM

UDC: 669.017

HIGH TEMPERATURE CREEP OF VT16 TITANIUM ALLOY

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 4, Jul-Aug 81 (manuscript received 7 Sep 80) pp 102-104

RODIONOV, V. N. and KARAKOZOV, E. S.

[Abstract] A study is made of the high temperature creep of VT16 alloy in compression in the 925-1050°C temperature interval, corresponding to the β area, at pressures of 2-10 MPa on cylindrical specimens 11.3 mm in diameter and 30 mm high. The results of the studies can be expressed by the following equation: $\dot{\varepsilon}=AP^{3.2}\exp(-174000RT)$, s^{-1}, where A is the structural sensitivity coefficient, R is the gas constant. Figures 5; references 5: 4 Russian, 1 Western. [41-6508]

UDC: 669.295

INTERACTION OF OXYGEN AND WATER VAPOR WITH SPONGE TITANIUM

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 5, Sep-Oct 81 (manuscript received 28 Jan 81) pp 50-54

ALEKSANDROVSKIY, S. V., VOROTINOVA, B. G., GOLIKOV, V. V. and KRASOTKIN, I. S., Leningrad Mining Institute, Department of Metallurgy of Light and Rare Metals

[Abstract] The method of labeled atoms is used to determine the degree of oxidation of metallic titanium in the process of magnesium-thermal production of metallic titanium as the vacuum separation apparatus is opened and the block of sponge titanium is separated, resulting in contact between sponge titanium and moist air. The initial material used in the study was sponge titanium obtained by the magnesium thermal reduction of titanium tetrachloride. The data obtained

showed that with ordinary moisture content of the air (less than 16 g/m^3), a monolayer of water is adsorbed onto the surface of the sponge titanium. At over 16 g/m^3, with holding times of over 16 hours, the quantity of water absorbed increased by a factor of 3 to 4 due to the capillary condensation processes. Subsequent vacuum drying did not completely remove the water. Figures 4; references 6: 5 Russian, 1 Western.
[35-6508]

UDC: 669.295'71'28'26:621.785.78

DECOMPOSITION OF METASTABLE β PHASE UPON CONTINUOUS HEATING OF TITANIUM ALLOYS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 52, No 4, Oct 81 (manuscript received 11 Jul 70, in final form 4 Dec 80) pp 829-837

POPOV, A. A., ANISIMOVA, L. I. and KIBAL'NIK, V. D., Urals Polytechnical Institute imeni S. M. Kirov

[Abstract] A study is made of the kinetics and orthology of decomposition of the metastable β phase in the process of continuous heating of alloys at 100°C/hr. Commercial titanium alloys types VT22 (Ti=5.3%, Al=4.4%, Mo=1.27%, Cr=4.5%, Fe), and VT15 (Ti=3.3%, Al=7.5%, Mo=10.6%, Cr) and alloys of the system Ti-3% Al-7% Mo-Cr with various contents of chromium (alloy 1-2.5%, alloy 2-5.3%) were used. The change in resistivity and modulus of elasticity were studied upon heating of the alloys following hardening to a β solid solution. Study of the changes in structure and properties of the hardened β-titanium alloys in the process of decomposition of the metastable β-solid solution showed that this process has several stages and allowed the nature of segregation of secondary phases in individual stages of decomposition to be established. The secondary phases are formed upon continuous heating by homogeneous and heterogeneous formation and diffusion growth of particles. Figures 6; references 7: 6 Russian, 1 Western.
[48-6508]

UDC: 669.295

TECHNOLOGICAL PROPERTIES OF TITANIUM ALLOYS

Moscow TSVETNYYE METALLY in Russian No 11, Nov 81 pp 27-31

KAGANOVICH, I. N.

[Abstract] The history of attempts to manufacture sheets 1 to 5 mm thick of Vt5 titanium alloy is briefly outlined. The main reason for the insufficient workability of this alloy is that it is an alloy with hexagonal close-packed crystalline structure. The presence of over 3% Al in Vt5 alloy results in low

ductility. A number of alloys were then tested containing from 2.5 to 3.5% Al, with Cr, V, Mn, Cu and Fe as β-stabilizers. All of these alloys could be satisfactorily deformed both hot and warm. Another example of work on improving the technological properties of alloys is the development of type 3 (3.5-5.0% Al, remainder Ti) alloy as a sheet alloy, which involved similar though less serious difficulties. A similar narrative with equivalent lack of detail is presented for the alloys Pt3V, Vt20 and Vt6s. Considering all of this, it is recommended that Vt5 and Vt5-1 and, in some cases, VT20, (for thin sheets and large stampings) be replaced with OT4 and VT6 alloys. Figures 3; references 5: all Russian.
[51-6508]

UDC 669.295.5:620.193

INFLUENCE OF ALLOYING ON TENDENCY OF TITANIUM ALLOYS TOWARD SALT CORROSION

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 17, No 2, Mar-Apr 81 (manuscript received 10 Mar 80) pp 35-38

KOLACHEV, B. A. and TRAVKIN, V. V., Moscow Aviation Technological Institute imeni K. E. Tsiolkovskiy

[Abstract] The title study was carried out for the VT1-0 titanium and the alloys OT4 and OT4-1 (Ti-Al-Mn), VT14 and VT16 (Ti-Al-Mo-V), VT30 (Ti-Mo-Sn-Zr) plus the experimental Ti-Al and Ti-Mo systems. The surface corrosion caused by the salt solution (salt crust) did not materially change the elongation stability of the Ti-Mo samples at 400°C. These alloys show elongation stability increasing in the order Ti-2Mo < Ti-6Mo < Ti-12Mo < Ti-32 Mo. For OT4, Ti-4Al, VT14, and VT30 alloys, the samples with a salt crust have a lower rupture loading than the corresponding uncorroded metals. In general, the tendency of the Ti-Al alloy systems toward salt corrosion is increased by Mn and decreased by V and Mo. Alloys of the Ti-Mo system are not sensitive to this type of corrosion, but the addition of Sr or Sn causes the development of a tendency toward salt corrosion. Figures 5; references 5: 4 Russian, 1 Western.
[111-12027]

UDC 620.194

ALKALINE CORROSION OF VT1-0 TECHNICAL TITANIUM

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 17, No 2, Mar-Apr 81 (manuscript received 26 Dec 78) pp 105-106

VLASHCHUK, V. Ye., VOLKOV, V. B., ONOPRIYENKO, L. M. and SHELENKOV, G. M., Institute of Electrowelding imeni Ye. O. Paton, USSR Academy of Sciences, Kiev

[Abstract] Corrosion was observed in a flange constructed of VT1-0 alloy exposed to a solution of 11-14% NaCl plus 12-20% NH_4Cl at a pressure of 0.6 to 0.65 MPa and a temperature of 150 to 160°C. The flange was removed from the vacuum-evaporator and an evaluation was made of the mechanical characteristics and gas content of both the flange and a metal blank. Compared to the blank, the flange had a significantly higher concentration of deleterious impurities which reduced the plasticity and specific viscosity. The flange metal also showed the formation of a coarse-grained fabric. Both these factors contributed to an increase in corrosion. Figures 2; references 5: 3 Russian and 2 Western.
[111-12027]

UDC 620.194

CORROSION CRACKING OF TITANIUM ALLOYS IN CHLORIDE SOLUTION

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 17, No 2, Mar-Apr 81 (manuscript received 11 Jul 79) pp 102-103

ZIMA, M. N., MELEKHOV, R. K. and KOVAL', M. V., Physical-Mechanical Institute imeni G. V. Karpenko, UkSSR Academy of Sciences, L'vov

[Abstract] The tendency of Ti-Al alloys toward corrosion increases with increasing Al concentration up to a critical value of 4%. At this point, the pseudo-alpha phase changes to an α_2-phase. The critical strain coefficients for AT3 and AT6 alloys differ by 1.5 times in air and by 3 times in a 3% NaCl solution. Microphotographs taken of the corroded surfaces of the two alloys show some differences. Cracks formed in air on the surface of AT6 have a more indistinct relief and greater indications of viscous rupture than those formed on the AT3 surface. Fractures formed in the 3% NaCl solution at pH=6.5 and pH=1 are characterized by a sharper relief than those formed in air. The fracture surfaces generated in the acidic NaCl solution are significantly larger, have fewer indications of microplastic deformation, and therefore appear to have required less energy than those formed in the neutral NaCl solution. Figures 3: references 3: 2 Russian, 1 Western.
[111-12027]

UDC 539.016:546.821

INFLUENCE OF GAS-SATURATION ON STATIC STRENGTH OF TITANIUM ALLOYS

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 17, No 2, Mar-Apr 81 (manuscript received 8 Apr 80) pp 45-48

GERVITS, T. Ya., Institute of Mechanics, UkSSR Academy of Sciences, Kiev

[Abstract] An evaluation was made of the effect of the surface gas saturation and tendency to adsorb hydrogen on the static strength of the alloys VT1-0, VT14, and TS5 in a planar-stressed state. The specific deformation at a constant stress decreases with an increase in the hydrogen concentration. The yield and strength limits of VT14 and TS5 decrease both with an increase in the tendency to absorb hydrogen and with increasing thickness of the gas saturation layer. The latter does not exert an obvious effect for VT1-0. The conditions are given for determining the limits for plastic yield and strength based on two-directional stresses applied to isotropic materials. An increase in the tendency to adsorb hydrogen reduces the range of conditions over which these alloys may be safely used. Figures 6; references 4: all Russian.
[111-12027]

UDC: 669.295

PHOTOMETRIC SORTING OF SPONGE TITANIUM ON 'YANTAR''SEPARATOR

Moscow TSVETNYYE METALLY in Russian No 11, Nov 81 pp 26-27

LIKHTERMAN, V. A., SHIRYAYEV, R. Ye., CHERNOV, A. P. and KASHIRNYY, G. I.

[Abstract] The "Yantar'" bichromatic separator was used to sort sponge titanium. Specimens of technically pure titanium and unconditioned lumps were passed through the measuring chamber to adjust the levels of discrimination. Then experiments were performed on specimens consisting of defective lumps and technically pure titanium in equal proportions for final adjustment of the separator. Photometric sorting of sponge titanium achieves good rejection of burnt and oxidized lumps from among dark unconditioned varieties, of iron-containing lumps from among lighter varieties. Light burnt and slime-contaminated lumps are not as well separated due to differences in the optical characteristics of these individual types of defects. In general, the device is capable of satisfactory separation of titanium sponge lumps. References 6: all Russian.
[51-6508]

UDC: 546.3:669.295.5'71:669.788

PHASE COMPOSITION OF PRODUCTS OF HYDROGENATION OF TITANIUM ALLOYS

Moscow IZVESTIYA AKADEMII NAUK SSSR: NEORGANICHESKIYE MATERIALY in Russian
Vol 17, No 11, Nov 81 (manuscript received 8 Oct 80) pp 2048-2052

KOLACHEV, B. A., GONCHAR, V. Ya. and LISKOVICH, V. A., Moscow Aviation Technology Institute imeni K. E. Tsiolkovskiy

[Abstract] Results are presented from a study of the phase composition of the systems Ti-M-H over a broad range of hydrogen contents. The binary alloys were prepared by mixing sponge titanium with aluminum, electrolytic iron, nickel, manganese, electron-beam-melted vanadium, sintered molybdenum and niobium, distilled chromium, and graphite of spectral purity. Oxygen was introduced by the addition of a crushed alloy obtained in a plasma-arc furnace of sponge titanium and titanium dioxide. The alloys were saturated with hydrogen to a content of not over 2 mass % in quartz ampules containing the design quantity of titanium hydride - the hydrogen source. The content of hydrogen in the specimens was determined by combustion, the spectral method, and also x-ray methods developed by the authors. When hydrogen is dissolved in binary alloys of titanium with β-eutectoid and α-stabilizing metals, the alloying element is liberated from the solid solution with the formation of the corresponding intermetallide and titanium hydride. The products of interaction of alloys in the systems Ti-V, Ti-Nb with hydrogen are complex hydrides. In alloys of titanium with molybdenum, dissolution of hydrogen forms titanium hydride and the αphase. The products of hydrogenation of alloys of titanium with carbon and oxygen are titanium hydride and oxihydride or carbohydride. Figures 1; references 11: all Russian.
[50-6508]

UDC 620.194.810

ELECTRODE POTENTIAL KINETICS DURING CORROSION AND CORROSION-FATIGUE FRACTURE GROWTH IN α AND ($\alpha + \beta$) TITANIUM ALLOYS EXPOSED TO SALT SOLUTIONS

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 17, No 2, Mar-Apr 81
(manuscript received 9 Jun 80) pp 3-10

POKHMURSKIY, V. I. and KALAKHAN, O. S., Physical-Chemical Institute imeni G. V. Karpenko, UkSSR Academy of Sciences, L'vov

[Abstract] The title study was carried out for five Ti alloys--VT1-0, VT5, AT3, PT3V, and VT14--containing various amounts of Al, Mo, V, Cr, Fe, B, and Si. The kinetics curves for the electrode potential for these materials are characterized by a sequence of four changes: 1) a sudden shift in the negative direction at the moment of loading; 2) a monotonic drift toward more positive values for 10-25 minutes; 3) a stable period until the fracturing actually starts; and 4) a

strong jump toward a more negative value at the moment of fracturing. Under cyclic loading, the potential after the initial jump increases somewhat with increasing number of loading cycles. The critical time interval between the formation of the incipient crack in the alloy and the formation of the monolayer oxide film in NaCl solution is about 10 to 40 msec. During the time the surface is free from the film, the hydrogen ion is able to freely penetrate the surface, and H^+ and Cl^- ions are absorbed, resulting in solution and fracture propagation. Resistance to fracturing in the studied alloys decreases in the order VT5 > VT14 AT3, PT3V > VT1-0. Figures 3; references 30: 24 Russian, 6 Western.
[111-12027]

UDC: 669.295:620.186.1

INTERGRAIN SEGREGATIONS IN TECHNICALLY PURE TITANIUM

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 52, No 4, Oct 81 (manuscript received 5 Feb 80, in final form 28 Apr 80) pp 880-882

KRYUKOV, I. I., NESTEROVA, Ye. V., RYBIN, V. V. and RYBNIKOV, A. I., Scientific-Production Union for Study and Planning of Power Engineering Equipment imeni I. I. Polzunov

[Abstract] Scanning and transmission electron microscopy are used to establish that the embrittlement caused by long-term holding of low-alloy α-titanium alloys in the 400-600°C temperature range results from transformation in the boundary zones which can be reduced to segregations at the boundaries of barely soluble impurities always present in titanium with subsequent segregation of dispersed phases in these locations. Considering the accuracy of determination of the concentration of elements contained in finely dispersed inclusions by microscopic analysis, it is estimated that the phase which is separated in the process of long-term holding of low-alloy α-titanium alloys in the 400-600°C interval is an intermetallide with the complex composition Ti_2(Fe, Ni). The content of Fe and Ni in the intermetallide is determined by the chemical composition of the alloy at the heat treatment conditions. Figures 2; references 6: 4 Russian, 2 Western.
[48-6508]

UDC: 669.017

STRUCTURE AND PROPERTIES OF VT22 ALLOY AFTER ANNEALING AND THERMAL HARDENING TREATMENT

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 5, Sep-Oct 81 (manuscript received 2 Oct 80) pp 98-102

LYASOTSKAYA, V. S., KOKNAYEV, R. G., KOLACHEV, B. A., KRASNOYARTSEVA, L. S. and NOTKIN, A. B., Moscow Institute of Aviation Technology, Department of Metallography and Heat Treatment

[Abstract] A study is made of the influence of preliminary annealing on the structure and properties of $\alpha+\beta$-titanium alloy VT22 subjected to thermal hardening and aging after annealing, in order to improve ductility and stability of mechanical properties. The studies were performed on hot rolled bars 22 mm in diameter annealed at 770, 810, 840, 870 and 900°C for 1, 3 and 5 hours with subsequent cooling in air or with the furnace to 450°C, then further cooling in air. The annealed specimens were hardened from 720°C (holding 1 hour, quenching in water) then aged for 8 hours at 550°C. It was found that preliminary annealing can change the mechanical properties of the alloy in the thermally hardened state over a broad temperature interval. Preliminary annealing forms a structure which influences the properties in both the annealed and aged states. A combination of preliminary annealing with hardening and aging provides a good combination of mechanical properties and decreases the spread of mechanical properties in comparison with hardening by heat treatment including only heating, quenching and aging. In the process of annealing an $\alpha+\beta$ structure with large plates of α phase is formed, providing a high level of ductility. Subsequent quenching and aging, liberating the dispersed α phase, helps to increase the strength of the alloy. Figures 2; references 6: all Russian.
[35-6508]

UDC: 621.791.052:539.4:669.295

PARTICULAR CASES OF MECHANISM OF FORMATION OF PORES UPON WELDING OF TITANIUM ALLOYS OF GREAT THICKNESS BY MELTING

Kiev AVTOMATICHESKAYA SVARKA in Russian No 10, Oct 81 (manuscript received 30 Oct 80) pp 42-45, 50

NIKIFOROV, G. D., doctor of technical sciences and REDCHITS, V. V., candidate of technical sciences, Moscow

[Abstract] During welding of many active metals, particularly titanium alloys, gas-phase seeds are required, usually producing defects on the end surfaces of welded edges. The source of gas bubble seeds in these cases may be contaiminated areas on the surfaces of the plates on the reverse side or defect in the form of gas collectors or pores in the base metal. The conditions for transformation of a gas collector to a bubble seed during electron beam welding in a vacuum are more favorable than during arc welding in inert gases. Since collectors are located primarily along grain boundaries, the development of internal pressure within them may be accompanied by the formation of microscopic cracks, decreasing the fatigue strength of the joints. Diagrams of longitudinal and transverse cross sections of welding baths during electron beam welding are presented and the ratio of forces acting on the metal in the bath necessary to prevent undesirable metal flow is calculated. To increase the quality of welded joints in titanium alloys and other active metals by decreasing seam porosity, one must: 1) make more rigid the requirements for quality of the initial metal (minimum grain size, no defects in the form of gas collectors or pores); and 2) perform electron beam welding under conditions decreasing the influence of the vapor-gas channel on the formation of pores (for example by defocusing the beam, decreasing welding speed). Figures 4; references 10: all Russian.
[40-6508]

UDC: 621.791.72

TECHNOLOGICAL SPECIFICS OF ELECTRON-BEAM WELDING AT $1 \cdot 10^{1}$ to $1 \cdot 10^{-1}$ MPa

Kiev AVTOMATICHESKAYA SVARKA in Russian No 10, Oct 81 (manuscript received 19 Mar 81, in final version 21 Apr 81) pp 14-18

BASHENKO, V. V., doctor of technical sciences and DETSIK, N. N., candidate of technical sciences, Leningrad Polytechnical Institute imeni M. I. Kalinin

[Abstract] Earlier works showed that when accelerated voltages of 75 to 150 kV are used the electron beam energy in the intermediate vacuum of an electron-beam welding installation decreases, but the quantitative estimates of the decreases differed greatly. The present article presents experiments performed on an installation including an electron gun with an independent high-vacuum evacuation system. The losses of total beam energy were not great and did not influence the shape of the melted area as the pressure was increased in the chamber in this new installation. The influence of residual gas on the parameters of the electron beam was found to be manifested primarily in scattering of electrons, though limitation of beam flight length to 30-40 mm for low accelerating voltages of 20-30 kV allows the beam to be retained practically unscattered; the electron energy loss at 20 kV with a pressure of not over 10 Pa is not over 0.2% of the initial energy. Deflecting systems and devices using the signal of the electrons reflected from the joint to guide the beam to the joint can be used for intermediate vacuum welding. Materials with volatile components should be welded under intermediate rather than high vacuum, decreasing chemical composition alterations in the seam metal due to selective evaporation. Figures 5; references 16: 11 Russian, 5 Western.
[40-6508]

ZHAYREM MINERAL RESOURCES HAVE UNION-WIDE IMPORTANCE

[Editorial Report] Alma-Ata SOTSIALISTIK QAZAQSTAN in Kazakh 22 September carries on page 3 a 2,500-word article on the Zhayrem mines under the regular rubric "The Constructions of the 11th Five-Year Plan" written by Qalmuqan Isabaev. The article begins with a description of the new city that is growing up around the mines, emphasizing difficult local geographical conditions with ground water close to the surface and the many efforts being made to make the new city green and livable. Many of its major facilities, moreover, are being built on mine backfill lands.

Isabaev then turns to the history of the area, first explored geologically in 1908 but considered uninhabitable in spite of iron deposits. In 1928, however, mines began to be opened anyway, beginning with the Ktay Iron-Manganese Mine. Later, in 1931, a major photo survey was undertaken and still more mines, e.g., at Qarazhal and Zhomart, etc. were established and a permanent geological survey group was set up under the Qarazhal facility. By 1969 the efforts of this group, by then upgraded to expedition status, were concentrated on the Zhayrem area.

At this point the author takes up the story through Zhayrem director Sadyq Asatov, who traces development at Zhayrem from the first projects there in 1971 down to the present and beyond. It is clear from Asatov's remarks that Zhayrem will soon be a facility of union-wide importance (the manganese of the area already has this significance and the mines produce 30 percent of republic copper and 70 percent of its lead as well, in addition to large quantities of zinc and barium.)

Today there are two mines, a rock crushing factory, 23 kilometers of roads, a heating system, a television tower, a medical facility, a 500-student school and two kindergartens at Zhayrem, and ore has been produced since 1976. Future plans call for a Zhayrem ore enrichment combine and expanded living facilities as well as a major increase in production.

Asatov notes that 100 million rubles were invested in Zhayrem facilities in the last 10 years and that investment will rise to 204 million rubles in the next five years with ore enrichment facilities an area of major emphasis. The area is clearly planned as a major territorial industrial complex of the future. The article ends with questions on drinking and industrial water, problems that Asatov says are being solved.

9857
CSO: 1832/1043

CONSERVATION OF METAL IN INDUSTRY CALLED FOR

Moscow SOVETSKAYA ROSSIYA in Russian 4 Sep 81 p 2

[Article by L. Shimov, Section Chief for RSFSR Peoples' Control Committee: "Extra Weight"]

[Text] Metal, being embodied in machine tools, machinery and popular consumer goods, creates the necessary conditions for lifting the economy and the welfare of the country. The Soviet Union is in first place in the world in metal production, but the need for this production is still great. It is possible to reduce it not only at the expense of an increase in the volume of output, but by thrifty consumption of the finished product as well. In machine building during the 11th Five-Year Plan, for example, it is planned to reduce the specific consumption of rolled metal by no less than 18-20% on average, and of steel pipes by 10-12%. In construction, the extent of savings should be 7-10%.

Are these aims real? Entirely. Given the condition, of course, that in the matter of the conservation and effective use of rolled ferrous metal products we wid ourselves of the manifestations mismanagement and negligence. I am particularly emphasizing this because up until now examples of squandering the peoples' property have been not uncommon. In the second half of last year, for example, agencies for peoples' control of the RSFSR made more than 1200 persons answerable for poor conservation and use of metal. Monetary fines were levied on 10 officials. Several executives were removed from their positions. Many materials were turned over to the Public Procurator's Office.

If one were to speak in concrete terms, let us say at enterprises of the Urdmurtskaya ASSR in the Kostromskaya and Moscow Oblasts, more than 6,000 tons of rolled metal were found for which no storage facilities had been created. Similar facts were revealed during a check in Tyumenskaya, Tomskaya, Magadanskaya, Penzenskaya and Kuybyshevskaya Oblasts, and in Primorskiy and Krasnoyarskiy Krays.

What strikes one most often? The lack of equipped metal storage sites and shelving. Incoming products are carelessly unloaded, sometimes by dumping them right onto the ground. It is difficult, and sometimes even impossible, to search out a necessary profile or marking because no one had made out a tag with the descriptions when they should have....

At the Perm' Electrical Engineering Plant, more than 200 tons of fine sheet steel for electric generators was lost because of such an attitude to the peoples' property. About 10,000 tons of metal, including rolled structural and sheet steel, were "stored" over a lengthy period under open skies at the Beloretsk Tractor Leaf and Coil Spring Plant (in Bashkirskaya ASSR). The corrosion which showed up in time had an immediate effect on production quality. Losses from defective products rose by 24% at the factory.

More than 500 tons of sheet iron also became unusable at the USSR Minneftekhimprom [Ministry of the Petrochemical Industry] Asbestos Manufacturing Products Plant in Yaroslavskaya Oblast. The cause was the same.

Great metal losses arise at construction sites, particularly during installation of plumbing systems. In Udmurtskaya ASSR, for example, a water pipe 11 kilometers long was laid to an oil deposit. However, during a 3-year period, it...was not used, and was written off. The "Volgogradneftegazstroy" Trust also showed the most gross mismanagement: it transported pipes to sites under construction without considering actual demand for them. As a result, more than 7 kilometers of pipe remained unused; part of them has already been 'ripped off.'

What must be done, and how may losses be avoided? In the opinion of specialists, strict setting of norms for consumption will aid in educating people to the thoughtful attitude to metal. Unfortunately, as the check has shown, serious attention is not being devoted to this factor at all enterprises in the RSFSR. In Sverdlovskaya Oblast, for example, 26 plants did not meet the set norms last year. The excess was 27,000 tons. Many enterprises in Permskaya Oblast also permitted overconsumption of metal. An alarming position has arisen at Minstankoprom [Ministry of the Machine Tool Building Industry] plants located in Moscow Oblast. Here about 14,000 tons of metal products were lost because of product defects, inefficient layout and low use coefficients.

It also agrieves us that very many of the items produced at our enterprises are extremely heavy. Let us say, for example, the products from the Stavropol' Plant -- truck trailers -- are 1.5-2 times heavier than foreign-made equivalents.

Measures developed several years ago to provide a significant reduction in metal consumption have not as yet been realized. Nor are the products of the USSR Minchermet [Ministry of Ferrous Metallurgy] being efficiently used at the Yaroslavl' Fuel Equipment Plant or at the Lyudinovo Unit Plant of Minstankoprom.

Metal scrap is not being reduced at many enterprises during cutting. In Belgorodskaya Oblast, for example, filings account for a quarter of the wastage (about 15,000 tons) at a majority of the plants.

The fruits of inefficient consumption and a wasteful attitude toward the peoples' property are explained first of all by a lack of the necessary moral and material responsibility for each kilogram and gram of metal which is lost. Apparently, points which would stimulate one to an interested and thrifty use of items from the metallurgical industry must appear both in the system of economic indicators of enterprises' work and in the condition of socialist competition for labor collectives. The educational effect of such organizational measures will be very high.

9194
CSO: 1842/19

UDC: 669.017:538.6

MARTENSITIC CONVERSION OF Fe-Ni-Ti ALLOYS EXPERIENCING CELLULAR DECOMPOSITION TO AUSTENITE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 260, No 1, Sep-Oct 81
(manuscript received 23 Apr 81) pp 88-90

SADOVSKIY, V. D., academician, ZEMTSOVA, N. D. and STARCHENKO, Ye. I., Institute of Metal Physics, Urals Scientific Center, USSR Academy of Sciences, Sverdlovsk

[Abstract] As in grain boundaries, particles of the excess phase in austenite have a barrier effect on martensite crystals, hindering the development of martensitic conversion and reducing the martensite point of alloys. In all previous works on the subject, the martensite conversion developed in a matrix undergoing continuous-mechanism decomposition. The Fe-Ni-Ti alloys studied in this work can undergo cellular austenite decomposition. The mechanism of development of martensitic conversion in colonies of cellular decomposition has not previously been studied. The metastable alloy $N_{26}T_3$ was produced in a vacuum induction furnace from pure initial materials, homogenized at 1200°C for 30 hours, forged into 10 x 10 mm rods, hardened from 1200°C then cooled to -196°C to achieve the direct γ to α conversion, heated to 1030°C cover 15 minutes to achieve the reverse α to γ conversion, the phase-hardened austenite was recrystallized and fine-grained austenite produced with high grain boundary mobility. Aging of this material at 800-820°C achieves a high degree of coarsely dispersed cellular decomposed material with liberation of a stable η phase and a metastable γ' phase. Analysis of crystallographic orientations indicates a high degree of coherence between the austenite and η-phase in colonies of the decomposed cellular material. Photomicrographs are presented. Analyzing the microstructures obtained, a mechanism is suggested for development of martensitic conversion in colonies: a seed of martensite grows in the austenite from one plate to the next. Stopped at the second plate, it creates strong elastic stresses in the thin coherent -phase plate, so that a wave of elastic stresses is transmitted to the next section of the austenite between plates and helps to continue the growth of the martensitic crystal due to the strict identical orientation of inter-plate austenite in one decomposition colony. Thin coherent plates of phase in the colony of the cellular austenite phase are thus natural labels which can be used to refine the crystal geometry of macroscopic shifts in the martensitic conversion. References 9: 5 Russian, 4 Western.
[17-6508]

UDC: 546.47.22:548.4

COMPOSITION OF GAS PHASE IN Zn-Se AND Cd-Te SUBLIMATION SYSTEMS

Moscow IZVESTIYA AKADEMII NAUK SSSR: NEORGANICHESKIYE MATERIALY in Russian Vol 17, No 11, Nov 81 (manuscript received 5 May 80) 00 1992-1995

GOLIUSOV, V. A., VORONIN, V. A., KLYMKIV, L. V. and CHUCHMAREV, S. K., L'vov Polytechnical Institute imeni Lenin's Komsomol

[Abstract] A study is made of the nonstoichiometry of the gas phase during dissociative sublimation in the production of zinc selenide and cadmium telluride, as well as determination of the composition of vapor over the growing crystal as a function of the vapor composition over the charge in Zn-Se and Cd-Te sublimation systems. Experimental data on the rate of mass transfer of zinc selenide obtained by the authors and of cadmium telluride taken from the literature were used to compute the composition of the gas phase in the source and precipitation zones. It was found that mass transfer in Zn-Se systems under the experimental conditions is limited by the transfer of matter from the evaporation zone to the precipitation zone. The limiting stage of sublimation mass transfer is thus turbulent diffusion. Values of the coefficient of turbulent diffusion in the Zn-Se system are calculated. The true total and partial pressures of the components in the Zn-Se system are determined in the source and precipitation zones. The variation in the nonstoichiometry factor of the gas phase in the precipitation zone from the nonstoichiometry factor in the source zone is calculated for the two systems in question. References 12: 1 Russian, 11 Western.
[50-6508]

UDC: 669.715:74

EFFECTIVENESS OF MODIFICATION OF ALUMINUM ALLOYS UPON CONTINUOUS CASTING OF Al-Ti-B MASTER ALLOY

Moscow TSVETNYYE METALLY in Russian No 11, Nov 81 pp 40-41

SHIPLOV, V. S., MOLODCHININA, S. P. and KOFMAN, L. M.

[Abstract] It has been found that the introduction of Ti to alloys together with boron is significantly more effective than the addition to Ti alone. Casting of ingots modified with titanium and boron leads to a great reduction in grain size (by a factor of 2 to 3), particularly in the peripheral zones. Strips manufactured of ingots modified with titanium and boron characteristically have greater homogeneity of mechanical properties. The introduction of 0.0005% B and 0.03-0.05% Ti decreases grain size by a factor of more than 2 and reduces the differences in grain size in ingots. Modification of aluminum alloys by this method during continuous casting improves the structure and properties of the ingots and improves their workability during deformation.
[51-6508]

UDC: (669.295 669.14)-416:621.7.044.2

INFLUENCE OF EXPLOSIVE WELDING PARAMETERS AND PRELIMINARY WORKING ON STRENGTH OF TITANIUM-STEEL BIMETAL

Moscow TSVETNYYE METALLY in Russian No 11, Nov 81 pp 51-53

BELYAYEV, V. I. and CHIGRINOVA, N. M.

[Abstract] Analysis of the quality of joints formed in a titanium-steel bimetal produced by explosive welding indicated that in order to produce the optimal combination of properties preliminary treatment of the surface of the titanium should be performed as follows: 1) titanium sheets are cleaned by abrasive treatment to remove microscopic irregularities, degreased with alcohol, then chemically etched in concentrated HNO_3 at 100°C and 0.5% HF at 70°C for 15 minutes-2 hours; 2) a thin layer of iron was applied to the titanium base by electrodeposition with subsequent heat treatment to increase the bonding force of the material of the substrate to the precipitated layer. The strength of welded joints at the optimal explosive pressure of 47 kbar is at least 170 MPa. The decrease in strength upon heating to 600°C for 100 hours is slowest at this optimal welding pressure with the titanium surface treatment described. Figures 2.
[51-6508]

UDC: 539.23:546.431.271

MICROSTRUCTURE AND ELECTROPHYSICAL PROPERTIES OF THICK FILMS OF BARIUM HEXABORIDE

Moscow IZVESTIYA AKADEMII NAUK SSSR: NEORGANICHESKIYE MATERIALY in Russian Vol 17, No 11, Nov 81 (manuscript received 25 Jun 80) pp 2028-2031

TEL'NIKOV, Ye. Ya., AKULOVA, L. T. and RUD', B. M., Institute of Material Science Problems, Ukrainian Academy of Sciences

[Abstract] A study is made of the structure and temperature variation of the resistivity of thick films, the current-conducting phase in which is barium hexaboride, while the binder phase is type Cd-22 glass. The barium hexaboride was obtained by boron-thermal reduction of barium carbonate under a vacuum. Specimens were obtained from pastes containing 40-100 mass % BaB_6, remainder glass. Information is presented on the complex structure of thick barium hexaboride-based films. A detailed study of the mechanism of electric conductivity and its interaction with the composition and microstructure can allow the electrical properties of thick films to be varied as desired. Figures 3; references 5: 2 Russian, 3 Western.
[50-6508]

UDC: 539.23.669.28

STRUCTURE AND ELECTRICAL PROPERTIES OF TiB_2 FILMS

Moscow IZVESTIYA AKADEMII NAUK SSSR: NEORGANICHESKIYE MATERIALY in Russian Vol 17, No 11, Nov 81 (manuscript received 29 Sep 80) pp 2032-2034

OSIPOV, K. A., YUSIPOV, N. Yu., BOROVICH, T. L., LAZAREV, E. M., KOROTKOV, N. A., MIROSHKINA, Ye. M. and SIPIKIN, Yu. P., Institute of Metallurgy imeni A. A. Baykov, USSR Academy of Sciences

[Abstract] A study is made of the structure and electrical properties of resistive films made of titanium diboride, one of the most resistant boron compounds to oxidation, as well as their temperature stability in a vacuum and in air. The structure of the films was studied by electronographic analysis and Auger-electron spectroscopy. The titanium diboride films were precipitated by ion-plasma sputtering of a target in an atmosphere of argon on sitall, polycor and sapphire substrates heated to 400°C. Surface resistivity varied from 240 to 1000 ohms with film thicknesses of 10 to 200 nm. The films were annealed in a vacuum at 600-1300°C and in air at 500-600°C for 30 minutes. The results of measurement of resistivity following annealing in a vacuum agreed with film structure analysis. After annealing in air, resistivity increased. TiB_2 films, both initial films and those oxidized by heating in air, were then studied by auger-electron spectroscopy, indicating that the initial TiB_2 films had a very thin oxide layer, 1-1.5 nm thick, on the surface. The thickness of the oxide layer increased to 10 nm upon heating in air for 30 minutes at 500°C, to 80 nm at 600°C, i.e., the mean rate of oxidation in air at 500°C was 20 nm/hr, at 600°C - 160 nm/hr. Figures 3; references 4: all Russian.
[50-6508]

UDC: 669.295:539.371

TEXTURE AND ANISOTROPY OF YOUNG'S MODULUS OF SHEETS OF Ti-Al-V ALLOY UPON LONGITUDINAL AND TRANSVERSE ROLLING

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 4, Jul-Aug 81 (manuscript received 8 Jan 81) pp 94-98

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[Abstract] The anisotropy of Young's modalus in rolled sheets is represented as a harmonic Fourier series to allow directed development of elastic anisotropy and of the texture which causes it in the commercial alloy Ti-3Al-1.5V. The initial material consisted of 3-mm sheets of the alloy obtained by rolling in a neutral medium of 800°C. Rectangular specimens were cut from the sheets in various

directions each 18° to measure Young's modulus. It was found that the cold rolling of alloy sheets leads to texture transformation. The anisotropy of Young's modulus is determined primarily by the contribution of the second harmonic of the expansion of the function $1/E=f(\phi)$ into a Fourier series for small and great degrees of compression and identical contribution of second and fourth harmonics for moderate deformations. When rolling is conducted in the transverse direction with respect to the initial direction, the anisotropy of elastic properties varies over a broad range depending on the initial texture and relationship of degrees of various types of deformation. References 8: 4 Russian, 4 Western.
[41-6508]

UDC: 535.211:545.211

EXPERIMENTS ON EFFECTS OF LASER RADIATION ON FLATTENED DIAMONDS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 5, Oct 81
(manuscript received 14 May 80) pp 39-42

VASIL'YEV, K. D., KULAKOV, V. M., SIPYAGIN, V. V. and UGLOV, A. A., Moscow

[Abstract] A study is made of the problem of expansion of the area of utilization of laser radiation for processing of minerals, particularly coating of flattened diamond and plates 0.4 to 2 mm thick or more, as well as splitting of spinel twins in the direction of twinning and in the plane perpendicular to it by means of laser radiation. A neodymium laser installation was used. The specimens were held at an angle of ~68° to the laser beam, which coincides with the angle of natural twinning of the diamond crystal. Photomicrographs of fracture planes of the crystals are shown. It is demonstrated that it is possible in principle to use laser radiation for these purposes. The results of action of the laser radiation depend on the direction of cutting and are satisfactory only when cutting is performed along natural twinning lines. Figures 4; references 4: all Russian.
[38-6508]

UDC: 535.211

SPECIFICS OF LASER IRRADIATION OF POROUS MATERIALS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 5, Sep-Oct 81
(manuscript received 14 Sep 79(pp 17-21

UGLOV, A. A., VLASOV, Ye. N., GREBENNIKOV, V. A., PANAYETOV, V. G., GARBUZOV, V. N. and ANDREYEV, Ye. I., Moscow

[Abstract] Some results are presented from studies of the effects of a laser beam on porous materials obtained by powder metallurgy methods. The experiments were performed on specimens of the magnetic alloy YuNDK35T5, with porosity 0-30%,

sintered nickel with porosity 0-60% and porous bronze with porosity 0-30%. Standard specimens were treated with pulsed laser radiation until a number of depressions were formed, 8-10 pulses per specimen. Laser pulse length was 2 ms, pulse radiation energy 8, 12 and 16 J, with the beam focused on the surface of each specimen. It was found that increasing porosity resulted in an increase in depth and diameter of the holes made. The mass of metal expelled varied with porosity with constant radiation energy per pulse. Metallorgraphic studies indicated that the metal in the area adjacent to the hole often included a zone of melted metal and an additional zone of thermal effects. Figures 4; references 6: all Russian.
[38-6508]

UDC: 669.295.087.48

PRODUCTION OF TITANIUM POWDERS BY ELECTROLYSIS OF CHLORIDE-FLUORIDE MELTS WITH SOLUBLE ANODE

Moscow TSVETNYYE METALLY in Russian No 10, Oct 81 pp 83-84

NERUBASHCHENKO V. V., OLESOV, Yu. G., SHAPOVAL, V. I. and DOVGAYA, G. P.

[Abstract] A study is made of the parameters of the process of electrolysis under which introduction of minimum quantities of fluorine-containing salts to the electrolyte has the greatest influence on the indices of the process of electrolysis and allows an increase in the content of powder fractions in the cathode metal. Studies were performed on a large laboratory sealed cassette type of electrolyzer retort (up to 100 A direct current) made of stainless steel. The anode material was type TG-Tv low-grade sponge titanium. The base of the electrolyte was an equimolar mixture of NaCl and KCl, into which lower chlorides of titanium were introduced as a solid salt melt. The studies performed showed that the influence of the content of the fluorine ion in the electrolyte on the basic parameters of the process of electrolysis is clearly seen upon transition from pure chloride to chloride-fluoride melts with F:Ti = 1.5:1. As the F:Ti ratio in the electrolyte was increased, the content of fluorine in the cathode metal changed very slightly, remaining at the level of some thousandths of 1%, while the content of chlorine decreased sharply. The quality of electrolytic titanium powder improved greatly with respect to iron content upon transition from fluoride to chloride-fluoride electrolytes. The studies demonstrated the promise of technology of electrolytic production of titanium powder in chloride-fluoride electrolytes in comparison to chloride electrolytes. Figures 2; references 6: all Russian.
[43-6508]

UDC 620.194.8:669.715:669.14.018.27:620.19

INFLUENCE OF WATER AND ITS INHIBITION ON KINETICS OF FATIGUE CRACK DEVELOPMENT IN V95 ALLOYS AND 65G STEEL

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 17, No 2, Mar-Apr 81
(manuscript received 14 Oct 78) pp 10-15

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[Abstract] The title investigation was carried out in the air, distilled water, and distilled water plus $NaNO_3$, H_2O_2, $K_2Cr_2O_7$, lutidine, or the inhibitor KI-1 for 65G steel and the three alloys V95AT1, V95AT3, and V95pchT1. Loading, environment, and sample composition all exert an influence on the formation of fatigue cracks. The rate of fracture formation increases with a decrease in the concentration of free oxygen in the environment. Traces of H_2O_2 in the water inhibit the fractures to a greater extent than reducing the maximum loading K-max. The lutidine generally provides the best inhibition. Decreasing the iron and silicon contamination of the alloys generally decreases their sensitivity to the corrosive effects of water in the above order. The steel is more sensitive than the alloys. Visual features of the fractured surfaces can be related to the loading regime -- low, average, or high -- to which the sample had been subjected. Figures 1; references 17: 12 Russian, 5 Western.
[111-12027]

UDC 620.193.82:629.12

CORROSION AND CORROSION-FATIGUE RESISTANCE OF STEELS UNDER MARINE AND LABORATORY CONDITIONS

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 17, No 2, Mar-Apr 81
(manuscript received 29 Nov 79) pp 15-21

KOBZARUK, A. V., BALATSKIY, L. T. and STEPANOK, N. A., Physical-Mechanical Institute imeni G. V. Karpenko, UkSSR Academy of Sciences, L'vov

[Abstract] Rates of corrosion were measured on both stressed and unstressed samples of 15KhN5DMF steel exposed to seawater and a 3.5% NaCl solution in the laboratory. The samples were subsequently subjected to low-frequency (0.017 cycles/sec) loading in air, flowing seawater, and a 3.5% NaCl solution. Corrosion rates for the cyclically deformed samples were 2 to 3 times greater in seawater and 5 to 7 times greater in the salt solution than those for the undeformed samples. Material exposed to seawater under natural conditions was also corroded biologically by sessile animals, notably red algae. Natural seawater influences the fatigue strength and stability of the steel toward corrosion to a greater

degree than seawater or salt solutions in the laboratory. Electron micrographs indicate that the type of corrosion is a function of experimental conditions. In a stagnant aggressive environment, pitting is predominent; in conditions conducive to oxygen depolarization, corrosion is by small craters and blemishes. Corrosion of samples exposed to natural marine conditions results in greater and sharper relief of the surface than that of samples exposed in the laboratory. Figures 5; references 9: 7 Russian, 2 Western.
[111-12027]

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